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Contents

Cover photograph: *Anax guttatus* exuvia in a New Territories pond; see p.24 (photo by Graham Reels)

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Preliminary observations on the nesting biology of *Trypoxylon petiolatum* Smith, 1858 (Crabronidae, Trypoxylini) in Hong Kong

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Abstract

Four nests comprising 16 cells of *Trypoxylon petiolatum* were reared from trap nests. The content was noted at trap opening and development of larvae recorded. In general the biology of this species agrees well with what is known about the genus (Nambu 1966, 1967; Krombein 1967; Bohart and Menke 1976; O'Neill 2001). It was noted that: the wasp is a cavity nester; this species is relatively specialised in its prey choice, with 72% of prey items being salticid spiders; the apparent requirement for very moist partition and plug construction material might impose restrictions on the possible nesting sites; and, by inference, the species is at least bivoltine if not trivoltine in Hong Kong.

Key words: *Trypoxylon petiolatum*, Crabronidae, Salticidae, Oxypodidae, sex ratio, voltinism.

Introduction

Trypoxylon petiolatum Smith, 1858 is a widely distributed species from India to the Far East and South East Asia, but little is known about the nesting behaviour of this crabronid, most of the literature on *Trypoxylon* concentrating on New World species. The status of *Trypoxylon petiolatum* Smith 1858 was revised by Tsuneki (1978, 1979 & 1981). Nambu (1966, 1967, in Japanese) produced detailed biological accounts on the species occurring in Japan including *T. obsonator* Smith, a junior synonym of *T. petiolatum* Smith.

The genus is cosmopolitan but poorly represented in Australia and some Pacific islands. To date 633 species have been described not including fossil taxa (Pulawski 2009), with certainly more to be discovered, particularly in central and south America where the genus attains its greatest diversity (Bohart and Menke 1976). It is divided into two subgenera, *Trypargilum* and *Trypoxylon*, the former only distributed in the Old World while the latter is distributed worldwide. In Hong Kong the author has recorded two species (*T. petiolatum* and *T. formosicola* Strand, 1922) and possibly a third one (pending identification).

All members of the tribe Trypoxylini hunt spiders for larval food, unlike most other species of Crabroninae, which generally provision their nests with various insects, either imago or larvae[1]. In the genus *Trypoxylon* there appears to be no general specificity in prey selection with a wide range of spider families being used.

Trypoxylon nests are fashioned out of mostly pre-existing cavities such as burrows left by wood-boring beetle larvae and bees, but also in hollow plant stems or in the ground. Near human habitats, any artefact presenting a tubular cavity will be used. Nests are composed of a linear set of cells divided by mud partitions and a final nest plug. Some species in the subgenus *Trypargilum* are known to fabricate free-standing mud structures, long cemented tubes bundled together on a suitable substrate, these are collectively known as the "pipe-organ wasps". A few species in the same subgenus have been reported to be gregarious, females building nests in close proximity to each other without any aggressive competition over the nesting site. One aspect deserves mention, the well documented behaviour of males in some species of *Trypargilum* actively guarding the nesting site in the absence of the female (Krombein 1969; Bohart & Menke, 1976; O'Neil 2001). Males are also reported to assist the females in nest preparation and construction, placing prey items in the cells and helping with the closure of the cell.

Observations of this common, medium sized but elusive species were carried out on trap nests at the end of May and beginning of June 2009, at Pak Sha O, Sai Kung Country Park, Hong Kong.

Methods

The traps consisted of hollow bamboo canes that were cut so that one end was closed by a nodal septum, they were of various length and diameter, four to seven segments bundled together and hung from low branches on various bushes and trees. Six bundles totalling approximately 40 segments with diameters of 3 to 6 mm were set between May and July 2009. Traps were inspected regularly and those with obvious wasp activity were either kept for rearing – sealed in a plastic "Ziploc" bags – or replaced in-situ if brood/prey were lacking. The four bamboo traps were collected between 22 and 31 May 2010. The traps were located in and collected from the author's garden, Hong Kong, Pak Sha O; UTM: 50Q KK 237 850, alt. 70m asl. The garden is situated on an old and abandoned *Citrus* spp. orchard, adjacent to a mature secondary forest, at the bottom of the north slope of a small hill.

Detailed analyses of trap content were carried out on four reared nests, comprising 16 cells, in June 2009. Quantitative data pertaining to brood, parasites, prey provisioning, cell dimensions, etc. were obtained upon trap opening, as well as through regular inspection of the brood development. The

identification of spider prey to species level was undertaken visually based on photographic plates provided by Tsim (2007).

Field observations of nest construction and provisioning were also recorded on two traps. Presence of adults in the study area was monitored continuously by one resident Malaise trap.

Results

The data are presented in Tables 1, 2 & 3.

Nest description

Table1 summarises the data pertaining to the dimensions and content at opening of each occupied trap-nest from which *T. petiolatum* emerged.

The cells were separated by cemented partitions, convex and smooth towards the entrance, irregular posteriorly. The partitions were composed of mixed material (sand grains, clay and possibly organic material).The plug was composed of the same material but applied in a much thicker layer. On all nests dissected, I systematically recorded the following characteristics:

- each nest had a vestibular cell defined by the last cell partition and the nest plug;
- all the first cells started directly from the bottom of the tube with no adjunction of material; and
- no empty intercalary cells were present.

Nests were made inside small diameter segments, as could be expected from “key-hole wasps”. The recorded diameters varied from 3.7 to 5.7mm (mean = 4.35, n = 4). The mean cell number per trap was found to be four (n = 16) for trap lengths varying from 155 to 195mm (mean = 176.3, n = 4). Cell length varied from 14 to 55 mm (mean = 24.88, n = 16) (Table 3).

Figure 1shows the typical content of a nest trap at opening.

Prey items

Table 2 shows the record of prey for each of the 16 cells analysed. Each cell was mass-provisioned with three to six prey items. An overwhelming majority of these were jumping spiders, Salticidae (72%), while a little less than a third were crab spiders, Oxypodidae (28%), the latter only represented by immature specimens of apparently the same species. In the Salticidae there was a visible preference for two species: Unidentified sp1 (25%) and *Epocilla calcarata* Karsch, 1880 (20%).

All specimens were lightly paralysed; able to move some appendages (pedipalps and legs) and spin some silk.Typical prey content of one trap is shown in Figure 1.

Cell 1 of trap PSO-046.A4 had a full prey provision but no eggs. The tube was kept after emergence of adult wasps until 5 July; although dead, the prey had remained in a remarkable state of freshness, with no sign of decay.

Brood development

Development of the brood was observed in four traps, comprising 14 active cells. Two cells (12.5% of the total) contained prey but no eggs, for reasons that were not related to parasitism (no instances of brood parasitism were in fact recorded). Each active cell contained a single egg, larva or pupa. The eggs were laid latero-ventrally on the abdomen of the prey, attached anally close to the abdominal cephalothoracic junction (Figure 3). From observations at trap opening, it appears likely that the eggs were laid on the last prey item brought into each cell.

Upon hatching, the grub remained fixed to its attachment and fed externally on the latero-ventral side of the abdomen of the prey. After almost completely consuming the first item (leaving only parts of the appendages), the larva sought another provisioned prey item and continued feeding, this time devouring the prey from any angle. As the grub developed it became darker save for the anal end filled with light-coloured meconium, later discharged in the cocoon.

The pre-pupal larva spun a single-layered cocoon not adherent to the tube sides. The cocoon material was cream in colour, very thin and easily crumpled, like paper. However, a fine silk diaphragm was woven on the anterior end of the cell, either right against the cell partition or before it, depending on the length of the cell. All 12 adults from the four traps emerged between 18 and 22 June.

The eggs hatched in approximately two days (mean = 2.5, n = 4). The mean development time from oviposition to last instar larva was seven and a half days (n = 9) or five days of larval stage. The mean time from oviposition to emergence was 25.5 days (n = 11) equating to 18 days of pupation time

Sex ratio

Sex ratio information was obtained from 11 cells in four traps (Table 1). A male bias was evident (58% to 42% females).

Larval mortality

Eggs and larvae may experience mortality during the developmental stages for reasons unrelated to parasitism. This was noted (Table 1) in two instances over 14 active cells upon opening (14.29%).

Voltinism

Nesting was observed only at the end of May on one bundle. The traps that had not been occupied by then remained empty during the rest of the summer or were occupied either by ant colonies (mainly in the genus *Crematogaster*), a common

sphecid, *Isodontia diodon* (Kohl 1890) and some undetermined Eumeninae. It took a little less than four weeks to complete the development of one generation. Adult specimens were, however, caught continuously in one Malaise trap in the study area from the end of March to early October.

Field observations

Only fragmentary field observations of transportation, application of plug and cell partition material were obtained. Unfortunately, prey provisioning was observed only once (Figure 4). Therefore, it has been impossible to assess precisely the time necessary to complete (build and provision) one cell and consequently the time necessary to complete a nest. However, the limited data suggest that a nest of four cells may be completed in two days.

Construction material foraging trips were time-recorded for two traps used by the same adult female, who made 12 trips over a period of 13.55 minutes (mean = 67.75 seconds per trip). The ball of material – a coarse wet assemblage of sand grains, soil and clay – was carried ventrally with the aid of the mandibles and the forelegs. The wasp spent 20-30s inside the nest applying the material. In doing so, she produced a stridulating noise, similar to that of larger sphecids.

In transporting prey, the wasp grasped the pedipalps and/or the front legs of the prey with her mandibles while locking the load ventrally with the forelegs, flying to the nest entrance. The spider was carried venter up and dragged between the wasp legs into the nest.

For both construction material and prey provisioning the wasp entered the nest head-first and exited metasoma first, unable to rotate inside the small cavity. Upon leaving for foraging the wasp never closed the nest entrance.

A graphical summary of these on-nest behaviours is given in Figure 5.

Conclusion

The nesting biology of this species agrees well with what is known generally about the genus (Nambu 1966, 1967; Krombein 1967; Evans 1970; Bohart and Menke 1976; O'Neill 2001). However, it should be noted that:

- *T. petiolatum* was clearly a cavity nester in Hong Kong, and therefore can be assumed to use pre-existing cavities in plant material as nesting sites, although members of this genus have been recorded from a variety of sites, both natural and man-made as well as being able to construct complete mud nests as with other Aculeata (Bohart & Menke, 1976; O'Neill, 2001). In particular *Trypoxylon rejector* Smith, synonymised with *T. petiolatum* by Tsuneki (1979), has been observed to construct free-standing, upright nests affixed to straw (Richards 1934). Another slight difference with the known biology of this species appears in the mean nest diameter of 4.35mm, noted to be smaller by approximately one third to the mean value of 6.3mm recorded for *T. obsonator* (Nambu 1966).

- The wet material used for partitions and plugs implies that it was extracted from a wet source. Additionally, the short foraging trips (approximately 60s) may indicate that this source was close to the nest. This may be a limiting factor in nesting site selections, to where suitably moist material is available (O'Neill 2001).

- All the prey items were foliage dwellers that Krombein (1967) calls the wandering or vagabond group of spiders, as opposed to ground dwellers, and none of them were web spinners. In fact *T. petiolatum* was found to be rather specialised in prey item selection, which is consistent with Nambu's (1966) observations for *T. obsonator*, where over 70% of the prey were from the Salticidae family, a near specialisation that is not well documented for most species in the genus.

- A rather short development time of 25 days from egg laying to emergence of adults, coupled with persistence of adults from March to October and the known voltinism of species in this genus in North America (Krombein, 1967), suggests that in Hong Kong *T. petiolatum* could have at least three generations yearly. However, Nambu (1967) reported that in the Tokyo region *T. obsonator* was bivoltine with the second generation overwintering. He also observed that the development time was on average 32 days, one week longer than that observed during the present study. Additionally, it should be noted that trap nests were only colonised once in the current study, in late May. This was probably the consequence of poor selection of trapping sites, supersedure and occupation by other Aculeata and a relatively small number of set traps. Further investigation is necessary to establish the true voltinism of the species.

- Although brood parasitism was never recorded it has to be noted that the sample size is small and therefore, results are certainly biased. Instances of parasitism and/or nest associates are certainly present in this species, particularly as it does not close the nest entrance when departing for foraging trips, leaving the "door open" to a number of parasites, and nest associates as recorded in the genus (Krombein 1967) are well documented for *T. obsonator* where nests could be infested by Tachinid flies (Nambu 1967).

- For possibly the same reason (small sample size), the sex ratio obtained is male-biased[2] although this bias is confirmed for *T. obsonator* in the Tokyo region (Nambu 1967) with 73% males for 23% females.

- Larval mortality (not related to brood parasitism) was noted in 14% of active cells, which if combined with the presumed effect of parasitism would amount to significant mortality of egg and larva in the natural populations. This has been well documented for New World species with total mortality attaining nearly 60% of all cells in some species (O'Neill 2001).

- The pre-pupal larva spun a pupating chamber defined by the posterior partition and a silk operculum on the anterior side of the cell.

Further detailed field and laboratory studies will allow for a finer understanding of the biology of this species and genus particularly with regard to nesting behaviour, brood development, parasitism, sex ratio and voltinism.

Endnotes

[1] Although some members of the tribe Miscophini (Crabronidae) also provide spiders as larval food.

[2] Jon Seger proposed in 1983 (Seger 1983) a model by which the sex ratio could be predicted to be 1:1 (female : male) for univoltine wasps and male biased if the wasp species was bivoltine or more. Unfortunately, the small sample size of the study does not permit confirmation of the applicability of Serger's model for *T. petiolatum* in Hong Kong.

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The author is grateful to Alexander V. Antropov, Senior Scientist and Curator of Hymenoptera collections Zoological Museum of Moscow State University, Moscow, Russia, for the identification of *T. petiolatum* specimens as well as patiently reviewing the original manuscript and Wojciech J. Pulawski, Curator, California Academy of Science, San Francisco, USA for reading and commenting on these observations. I would also like to thank Graham Reels, Hong Kong for providing valuable advice to the content of this paper as it developed.

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Table 1a. Trap content

Trap ref.	Trap set	Collected	Diam. (mm)	Length (mm)	Cells	Eggs	Larvae	Pupae	No. of prey	Mean no. prey/ cell	Cells with no eggs
PSO-046.A3	6-May-09	31-May-09	4.3	195	5	3	1	0	25	5	1
PSO-046.A4	6-May-09	22-May-09	5.7	195	5	4	0	0	19	3.8	1
PSO-046.A6	6-May-09	26-May-09	4	160	4	2	2	0	18	4.5	0
PSO-046.A7	6-May-09	31-May-09	3.4	155	2	2	0	0	7	3.5	0
Total					16	11	3	0	69		2
Mean			4.35	176.25	4.00				17.25	4.31	
%											12.50%

Table 1b. Brood death, parasitism and sex ratio

	Larval death, excl. parasitism		Parasitism		Sex ratio		
Trap ref.	Active specimens at opening	Dead specimens	No. of cells	No. of cells paras-itised	No. of active cells	Female	Male
PSO-046.A3	4	1	5	0	3	2	1
PSO-046.A4	4	1	5	0	3	1	2
PSO-046.A6	4	0	4	0	4	1	3
PSO-046.A7	2	0	2	0	2	1	1
Total	14	2	16	0	12	5	7
Mean							
%		14.29%		0.00%		41.67%	58.33%

Table 2. Prey

			Prey details							
			Salticidae							Oxypodidae
Trap ref.	No. of cells	No. of prey	*Epocilla calcarata*	*Chrysilla versicolor*	*Carrhotus sannio*	*Rhene flavigera*	*Cytaea* sp1	*Salticidae* sp1	*Salticidae* sp2	*Oxypodidae* sp1
PSO-046.A3	5	25	1	0	1	2	0	6	7	8
PSO-046.A4	5	19	9	1	1	1	1	3	0	3
PSO-046.A6	4	18	4	0	2	0	0	2	3	7
PSO-046.A7	2	7	0	0	0	0	0	6	0	1
Total	16	69	14	1	4	3	1	17	10	19
%			20.29%	1.45%	5.80%	4.35%	1.45%	24.64%	14.49%	27.54%
								% Salticidae	72.46%	

Table 3. Cell dimensions

Trap ref.	Max. diameter (mm)	Segment length (mm)	Number of cells	Length Cell 1 (mm)	Length Cell 2 (mm)	Length Cell 3 (mm)	Length Cell 4 (mm)	Lenght Cell 5 (mm)	Mean cell length (mm)
PSO-046.A3	4.3	195	5	44	27	17	24	21	
PSO-046.A4	5.7	195	5	20	20	20	20	20	
PSO-046.A6	4	160	4	25	20	30	55	_	
PSO-046.A7	3.4	155	2	21	14	_	_	_	
Mean	4.35	176.25	4.00	27.50	20.25	22.33	33.00	20.50	24.88

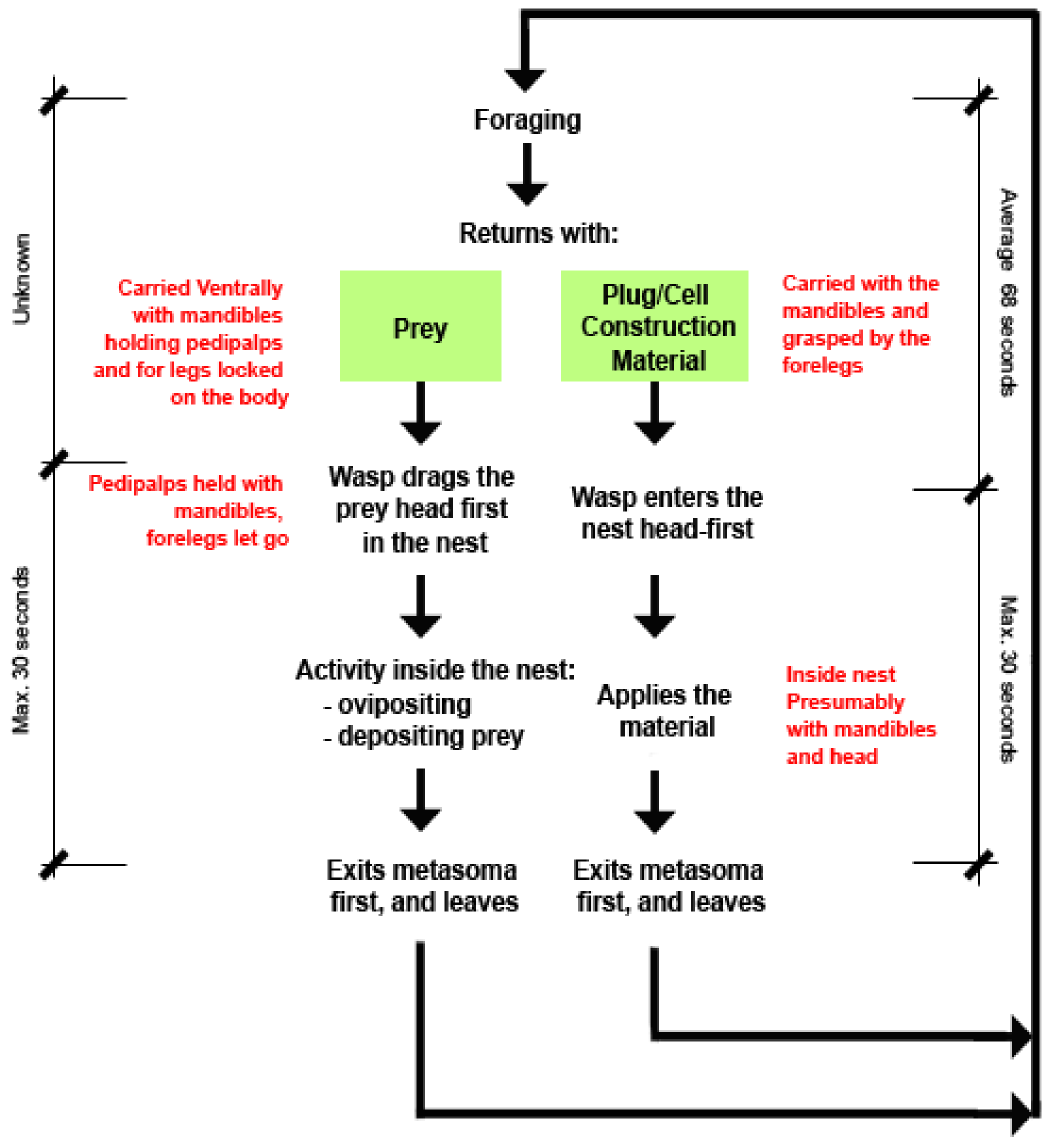
Figure 1. Trap PSO-046.A6. Trap inside view and prey content at opening. (Photo author).

Figure 2. Trap PSO-046.A6 six days later. Cell 1 & 2 contains freshly spun cocoons (top).
Cell 3 & 4, contains mature larvae consuming the last prey (bottom). (Photo author).

Figure 3. Oviposition site on prey. (Photo author)

Figure 4. Left, cell partition material provision. Right, prey provisioning. (Photos author).

Figure 5. *Trypoxylon petiolatum*, nesting activity diagram.



New records of the family Phalacridae from Hong Kong (Coleoptera: Cucujoidea)

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Key words: Phalacridae, shining mould beetles, China, checklist, privet, *Ligustrum*

Introduction

The Phalacridae is a family of small, round, glabrous beetles with rather homogeneous external morphology. Members are commonly collected by sweeping grasses, dead vegetation, and flowers, and most feed on microfungi in these habitats as larvae and adults. Some feed within flower heads of certain Asteraceae as larvae and on pollen of various groups of dicots as adults. Because of their small size and uniform appearance they are among the most poorly studied groups of beetles worldwide. Generic limits and even identities are largely confused in non-Holarctic realms, and redefinitions and synonymies are sorely needed (Steiner 1984). Here we present a summary of the knowledge of the Phalacridae in Hong Kong, including two new country records for China. Two species were previously recorded from Hong Kong, bringing the total to four species, although one of these is likely a junior synonym. Phalacridae are most diverse in tropical and subtropical regions, and additional species are likely to be recorded from Hong Kong in the future.

One of us (Paul Aston) has been collecting and studying Coleoptera in Hong Kong for over five years. The collection, although from all regions of the Hong Kong SAR, is biased towards the large island of Lantau. Specimens are deposited in the AFCD collection in the Cheung Sha Wan Government Offices (AFCD-CSW) Hong Kong, China, and the Louisiana State Arthropod Museum (LSAM), Baton Rouge, Louisiana, USA.

Genus *Augasmus* Motschulsky, 1858

This genus is widespread and diverse in warm regions of the Old World. Habits of members of the genus are virtually unknown. It may be easily recognized by the following character states:

- hind tarsus elongate, filiform, with basal tarsomere subequal to or exceeding length of remaining tarsomeres;
- hind tibia with inner (ventral) apical ctenidium strongly obliquely oriented with respect to axis of tibia;
- metaventral process exceeding the mesocoxae anteriorly; and
- protibia with ctenidium on outer edge for at least half length of tibia.

Augasmus humilis (Guillebeau, 1893), new country record

Figure 1.
One male from Hong Kong: “Wang Tong, Lantau Island, 14 Oct 2009, P. Aston” (AFCD-CSW). The aedeagus of our specimen matches the aedeagal illustration in Lyubarsky (1994: Fig. 4). This is a small, bright testaceous species that is widespread in southeast Asia. This represents a new record for both Hong Kong and China.

Augasmus noteroides (Blackburn, 1895)

This species was recorded by Champion (1924: 239) from Hong Kong as *Parischius noteroides* (Blackburn). It may, in fact, be a synonym of *A. humilis*. A thorough review of the genus, including dissection of the types of this species, is sorely needed.

Genus *Phalacrus* Paykull, 1800

This is the most widespread genus of Phalacridae, occurring on all continents except Antarctica and nearly coextensive with the family as a whole. It is easily recognized by the following suite of character states:

- scutellum large, width at base greater than greatest diameter of eye;
- clypeal margin arcuate, strongly shelf-like and concealing antennal scape from above; and
- metaventral process strongly anteriorly protruding between mesocoxae.

Members are mostly pitch black in colour, but some are rufotestaceous or have striking maculations on the elytra.

***Phalacrus punctatus* Champion, 1925**

Recorded from Hong Kong by Champion (1925: 605). A medium-sized (2.5–3.0 mm), totally black species with punctate elytra.

***Phalacrus rufoguttatus* Lyubarsky, 1994, new country record**

Figure 2.

Three specimens (two males, one female) from Hong Kong: "Po Lin Monastery, Lantau Island, in flowers of *L. sinense*, 9 Apr 2009, P. Aston" (two in AFCD-CSW, one in LSAM). The adult beetles were discovered visiting flowers of Chinese privet, *Ligustrum sinense* Lour. (Oleaceae), the first biological information recorded for this species. This represents the first record of the species outside of the Philippines. It is easily recognized by the large red subapical maculations on the elytra.

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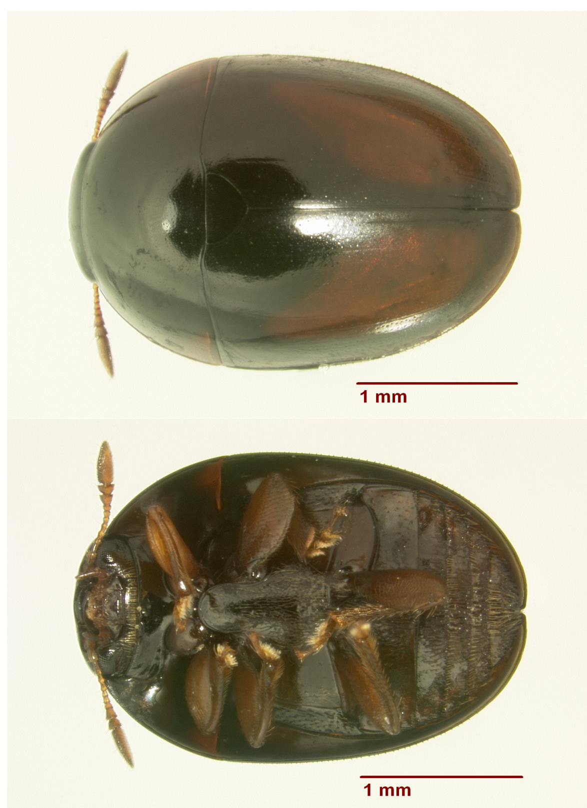
Figure 1. *Augasmus humilis* (Guillebeau). Adult habitus (abdomen removed).

Figure 2. *Phalacrus rufoguttatus* Lyubarsky. Adult habitus.



The genus *Macroglossum* Scopoli 1777 (Lepidoptera: Sphingidae, Macroglossinae) in Hong Kong

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Abstract

A review of the status of species from the genus *Macroglossum* in Hong Kong is given, along with a key to adults to aid identification of similar species in the field. Currently there are 18 species recorded from Hong Kong, though several of these have occurred only once. The ecology of the species is given, where known. Many species are diurnal or crepuscular and attracted to nectar-rich flowers, especially *Duranta erecta* L. (Verbenaceae). Larval hosts in Hong Kong are primarily from Rubiaceae. A further two species are candidates to be found in Hong Kong, based upon their known regional distribution.

Key words: Lepidoptera, Sphingidae, *Macroglossum*, checklist, Hong Kong, field identification key.

Introduction

The humming-bird hawkmoths of the genus *Macroglossum* Scopoli 1777 are well represented in Hong Kong. Being both diurnal and nocturnal, they are one of the more conspicuous elements of the Hong Kong moth fauna, especially due to their habit of nectaring from flowers whilst still in flight, hovering close in front of a flower for a few moments to probe with their long haustellum (i.e. proboscis, or tongue), from which the genus name (from the Latin prefix “macro” = big, large; and the Greek “glossa” = tongue) is derived.

The genus is one of the best documented groups of moths in Hong Kong, but the main literature (Tennent 1992, Li 1992, Li 1998, Kendrick, 2002 [2003]) is not readily available to aid identification of species within the genus, and there have been additions to the list since these publications. This paper thus aims to update the Hong Kong list, provide the current taxonomic status for each species and summarize the known local ecology of each species; and gives a field identification key to all but the rarest *Macroglossum* species found in Hong Kong.

Methods

Records of *Macroglossum* species found in Hong Kong are based upon published information. Primary works are Tennent (1992); Li (1992); Waring et al. (1994); Kendrick (2002 [2003]); as well as Kendrick (1998); Li (1998); Kendrick & Barretto (2008); and field surveys (light trapping and nectaring) undertaken by the author and material submitted for identification to the author, either as voucher specimens or as identifiable photographs.

Collections checked for records are as follows: The Natural History Museum, London, England (material collected by W.J. Tennent & A.C.Galsworthy), Kadoorie Farm & Botanic Garden (KFBG), Tai Po (material collected by the author, J.J.Young, A.C.Galsworthy and K.H.K.Li), Hong Kong University of Science & Technology (Li’s material for Li, 1992), the private collection of A.J.Palmer (Bournemouth, England) and the private collection of M.J.Sterling (St. Albans, England). Ecological data on larval hosts are based on published information for Hong Kong, plus unpublished data held in the notebooks of the late Kent Li. Habitat data is summarised from collecting data for specimens, as recorded either in the published literature, or from the specimen collection labels.

Further records have been submitted electronically to the author from A. Hardacre (Sai Kung) and from members of HKWildlife.net (2007 – March 2010) (http://www.hkwildlife.net), Hong Kong Moths Yahoo! group (January 2005 – March 2010) (http://tech.groups.yahoo.com/group/Hkmoths/), and Hong Kong Moths Flickr group (August 2007 – March 2010) (http://www.flickr.com/groups/hongkongmoths/). Photographs depicting *Macroglossum* specimens not identifiable to species with total certainty have not been included in this work.

Global distributions of species are based upon Pittaway & Kitching (2000-2010) and Kiching *et al*. (2010). Species distributions in China (given to province only, province names abbreviated as per Table 1), are based on Chu & Wang (1997) except for the *insipida* / *neotroglodytus* / *peocilum* and *heliophila* / *pyrrhosticta* / *variegatum* complexes (where misidentifications are an issue), on Wang (1995) for Taiwan and Easton & Pun (1996) for Macau. Geographic entities are used in preference to administrative and political boundaries where possible, following Kendrick (2002 [2003]), especially in Malaysia and Indonesia, where Malaya refers to the Malay peninsula (West

Malaysia), the Greater Sundas and the Lesser Sundas refer to the islands on the Sunda shelf that comprise Indonesia (other than New Guinea), Brunei and east Malaysia. Distribution in Hong Kong is given as either: widespread (recorded from at least 11 sites throughout the Special Administrative Region), local (recorded from four to ten sites, usually localised to one or a few districts), or restricted (recorded from up to three sites).

Table 1. Abbreviations of Chinese provinces and metropolitan areas for species distributions

AH	Anhui	HN	Hainan	SaX	Shaanxi
BJ	Beijing	HuB	Hubei	SC	Sichuan
FJ	Fujian	HuN	Hunan	SD	Shandong
GD	Guangdong	IM	Inner Mongolia	SH	Shanghai
GS	Gansu	JN	Jilin	SX	Shanxi
GX	Guangxi	JS	Jiangsu	TJ	Tianjin
GZ	Guizhou	JX	Jiangxi	TW	Taiwan
HeB	Hebei	LN	Liaoning	XJ	Xinjiang
HeN	Henan	MC	Macau	XZ	Xizang
HLJ	Heilongjiang	NX	Ningxia	YN	Yunnan
HK	Hong Kong	QH	Qinghai	ZJ	Zhejiang

Species are presumed to be resident in Hong Kong, unless stated. The status is determined by the number of observations of each species: rare – 1 to 3 records; scarce – 4 to 10 records; uncommon – 11 to 30 records; frequent – 31 to 100 records; common – over 100 records.

Results

The 18 species of *Macroglossum* recorded in Hong Kong are listed in Table 2, together with a summary of the status of each species, which month(s) records were made and what method(s) of observation was successful in finding each species.

In the following key, please note (a) all features referred to are on the dorsal surface of the moth unless specified; f/w = forewing; h/w = hindwing. Note that features can fade or wear off in older individuals and may not always be so easily seen; (b) the *M. variegatum* / *M. pyrrhosticta* pair and the *M. neotroglodytus* / *M. insipida* / *M. poecilum* group are rather variable in patterning and this key is based on the most common forms of each species that occur in Hong Kong; genitalia dissection of the latter group is the only way to be 100% certain of a correct determination; and (c) *Macroglossum sylvia* and *M. glaucoptera* are not included (see species texts).

Table 2. The species of *Macroglossum* recorded in Hong Kong, with annotated status, months observed and observation methods

Species binomial Author(s)	status	adult phenology	method(s) of observation
Macroglossum stellatarum (Linnaeus, 1758)	rare, migrant	10, 11	nectaring
Macroglossum bombylans Boisduval, 1875	rare	4, 6, 8-10, 12	nectaring
Macroglossum belis (Linnaeus, 1758)	uncommon	5, 7-9, 11	nectaring
Macroglossum mediovitta Rothschild & Jordan, 1903	scarce	5, 7-10	nectaring; light trap
Macroglossum neotroglodytus Kitching & Cadiou, 2000	scarce	8, 10, 11	nectaring; light trap
Macroglossum insipida Butler, 1875	common	3, 5-11	nectaring; light trap
Macroglossum poecilum Rothschild & Jordan, 1903	scarce	6, 7, 9, 11, 12	nectaring
Macroglossum sitiene Walker, 1856	scarce	1-3, 8-12	nectaring
Macroglossum heliophila Boisduval, [1875]	common	3, 4, 6-12	nectaring; light trap
Macroglossum pyrrhosticta Butler, 1875	common	1, 3, 4, 7-11	nectaring; light trap
Macroglossum variegatum Rothschild & Jordan, 1903	uncommon	4, 6-11	nectaring; light trap
Macroglossum glaucoptera Butler, 1875	rare, one record	6	nectaring
Macroglossum saga Butler, 1878	scarce	1-3, 10	light trap
Macroglossum fritzei Rothschild & Jordan, 1903	common	all year	light trap
Macroglossum sylvia Boisduval, [1875]	rare, one record	10	nectaring
Macroglossum corythus Walker, 1856	common	2-11	nectaring, light trap
Macroglossum passalus (Drury, 1773)	scarce	3-5, 7-9, 11, 12	nectaring
Macroglossum mitchellii Boisduval, [1875]	rare	3-5, 10	light trap

Key to months: 1 = January, 2 = February, .etc. to 12 = December.

Field Key to adults of *Macroglossum* species found in Hong Kong

1. h/w orange all the way from the base to the termen . . . . *M. stellatarum*

- h/w with dark brown or black basal patch and dark terminal zone, separated by an orange, yellow-orange or yellow band medially or sub-medially 2

2. f/w submedial band neither prominent nor contrasting strongly with the medial area 3

- f/w submedial band prominent and contrasting with the medial area 5

3 f/w sandy brown; h/w medial band orange with a diffuse border on the outer edge (Fig. 1) . . . *M. belis*

- f/w dark greenish brown with purple-lilac sheen; h/w yellow-orange or yellow, with little or no suffusion of the outer edge 4

4 f/w very uniform (Fig. 2), h/w medial band reaches the wing apex . . . . *M. corythus*

- h/w band about one quarter the width of the wing, not reaching wing apex (Fig. 3) . . . . . *M. saga*

5. abdominal segments 4 onwards blackish-green dorsally, head and thorax bright white ventrally *M. bombylans*

- abdomen and thorax uniformly coloured 6

6 thoracic striping wide, one central and one patagial black stripe, V shaped post-medial fascia (Fig. 4) . . . . *M. mitchellii*

- thin or flared thoracic stripe with a patagial triangle over the wing base 7

7. f/w submedial band has both edges straight . . . 8

- f/w submedial band with one or both edges curved, angled or sinuous 9

8. f/w basal area nearly as dark as the submedial band and significantly darker than the medial area (Fig. 5) . . . . *M. passalus*

- f/w basal area similar in colour to the medial area; submedial band strongly oblique, antemedian line with a conspicuous narrow pale line along the basal edge . . . . *M. fritzei*

9. f/w medial band white and straight (sometimes narrowing or broken centrally), bounded by blackish bands on both edges . . . . *M. mediovitta*

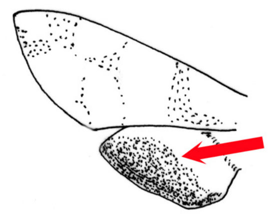
- f/w medial band not bound by straight fasciae on both edges 10

10. h/w band yellow-orange, with long central straight distal edge (Fig. 6), f/w medial band pale and with a straight basal edge . . . . *M. heliophila*

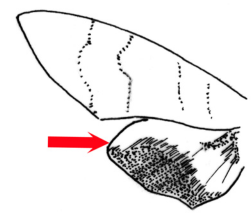
- h/w band curved centrally 11

Figures 1-12. Pointers to characters used in the identification key of *Macroglossum* species in Hong Kong.

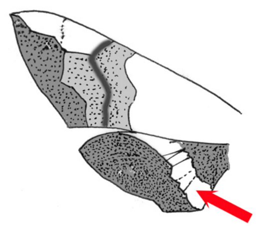
1. *M. belis*



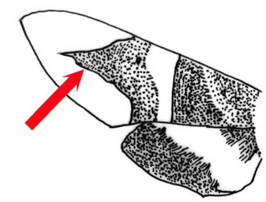
2. *M. corythus*



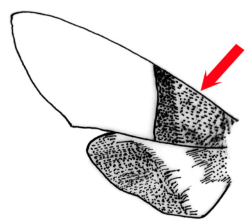
3. *M. saga*



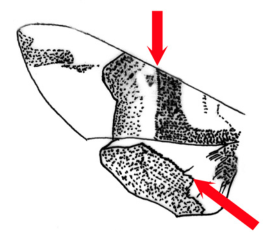
4. *M. mitchellii*



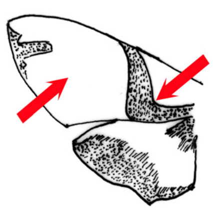
5. *M. passalus*



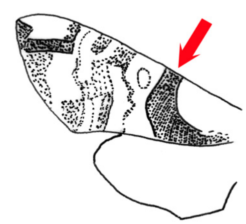
6. *M. heliophila*



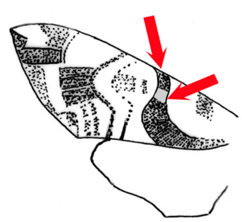
7. *M. sitiene*



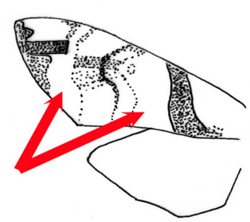
8. *M. neotroglodytus*



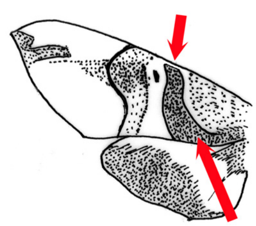
9. *M. poecilum*



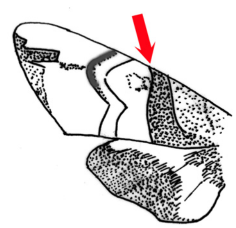
10. *M. insipida*



11. *M. variegatum*



12. *M. pyrrhosticta*



11. inner edge of the f/w submedial band turns in a right angle (90°) to the wing base (Fig. 7), no significant post-medial fascia, thorax pale green with a faint thin dorsal stripe . . . . *M. sitiene*
- inner edge of the f/w submedial band curves towards the wing base, thoracic stripe and patagial triangles prominent 12
12. f/w submedial band meets the costa approximately at 90° (Fig. 8) . . . . *M. neotroglodytus*
- f/w submedial band meets the costa obliquely . . 13
13. f/w submedial band with pale square (Fig. 9) filling the band near the costa . . . . *M. poecilum*
- f/w submedial band without pale discal square . . 14
14. f/w medial band uniformly pale purplish brown, matching the subterminal area (Fig. 10) . . . . *M. insipida*
- f/w medial band greyish-green or grey-brown, paler than the subterminal area 15
15. f/w submedial band stops just short of the costa, and is much wider at the dorsum, curving in to the base (Fig. 11); abdomen uniformly pale grey-brown ventrally . . . . *M. variegatum*
- f/w submedial band reaches costa, appears relatively straight and obliquely angled (Fig. 12); abdomen chestnut orange (with black patches when worn) ventrally . . . . *M. pyrrhosticta*

Species accounts

Macroglossum stellatarum (Linnaeus 1758) (Tennent, 1992: 100, Plate 5, Figs. 7 & 8)
Global distribution: northern Africa, southern Europe, Arabia through to Japan, China (JL, LN, IM, GS, HuB, HeN, SD, SX, HuN, FJ, GD, HK, SC, GX). H.K. distribution & status: restricted (Victoria Peak), rare - possibly only stray migrants occur in Hong Kong.
H.K. ecology: two records; October, November.
Similar species: separated from other *Macroglossum* species found in Hong Kong by the almost completely orange hindwing bordered by a very narrow dark brown terminal band and no lateral orange banding on the abdomen.

Macroglossum bombylans Boisduval 1875 (Tennent, 1992: 100, Plate 3, Figs. 1 & 2)
Global distribution: northwestern India, Nepal, China (BJ, HuB, HuN, HK, HN, TW), Korea, Japan, northern Thailand, N.Vietnam, Philippines. H.K. distribution & status: widespread, scarce.
H.K. ecology: multivoltine, flying in April, June and August to mid-October; one record from early December. Adults recorded only nectaring, at *Barleria cristata* L., 1753 (Acanthaceae) and *Duranta erecta* L. (Verbenaceae) (Li, 1992); occurs up to 450m elevation in shrubland, parks, secondary forest, and grassland.
Similar species: separated from other *Macroglossum* species by the combination of very white head and thorax ventrally, dark dorsal colour, on the hindwing the dorsal sub-basal patches have a very small amount of yellow, and white bases ventrally.

Macroglossum belis (Linnaeus 1758) (Figs. 1 & 13k)
Global distribution: eastern Pakistan, India, Sri Lanka, Nepal, Thailand, China (south, HK, MC, TW), Ryukyu Is., Java. H.K. distribution & status: widespread, uncommon.
H.K. ecology: possibly trivoltine, adult records from May, July to September and November; occurring in parks, shrubland and secondary forest up to 550m elevation. Observed at light and nectaring at *D. erecta and Lantana camara* L. (Verbenaceae). Reared by K.Li (pers. comm.) on *Paederia scandens* (Lour.) Merr. (Rubiaceae) and N. Tong (Li, 1992) on *Strychnos angustiflora* Benth. (Loganiaceae), the life cycle taking one month.
Similar species: separated from other *Macroglossum* species by the orange, rather than yellow, hindwing medial band, which has a very diffuse outer edge.

Macroglossum mediovitta Rothschild & Jordan 1903 (Fig. 13d)
Global distribution: southern Japan, southern China, Thailand, Malaya, Sumatra, Mentawai, Borneo, Philippines. H.K. distribution & status: widespread, scarce.
H.K. ecology: recorded in May and July through October, occurring up to 700m elevation in secondary forest and grassland; taken at light and also nectaring on *D. erecta* at dawn, mid-morning and dusk.
Similar species: *M. heliophila* always has the forewing medial band grey and complete, bounded apically with a diffuse greenish postmedial fascia and is slenderer and smaller. *M. mitchellii* has a wide dorsal stripe from the labial palps to the junction of the thorax and abdomen.

Macroglossum neotroglodytus Kitching & Cadiou 2000 (Figs. 8 & 13l)
Global distribution: southern & eastern India, Sri Lanka, Thailand, Vietnam, southern China, southern Japan, Malaya, Sumatra, Java, Philippines. H.K. distribution & status: widespread, uncommon.
H.K. ecology: recorded in August, October & November in grassland, parks and secondary forest up to 100m elevation. Adults mostly recorded nectaring at *D. erecta,* at dusk or dawn. Larva reared by K. Li on *Hedyotis acutangula* Champ. ex Benth. (Rubiaceae) and *H. hedyotidea* (DC.) Merr. and by N. Tong on *H. tenelliflora* Blume (K. Li, pers. comm.).

Similar species: see *M. poecilum*.
Taxonomic note: previously known as *M. troglodytus* Boisduval, 1875.

Macroglossum insipida Butler 1875 (Fig. 10); (Tennent, 1992: 103, Plate 4, Figs. 3 & 4)
Global distribution: south & east India, Sri Lanka, Thailand, Malaya, Gtr. Sundas, Philippines; other subspecies – New Guinea to Australia (Queensland). H.K. distribution & status: widespread, uncommon.
H.K. ecology: Noted from March and May through November, more commonly recorded in October, occurring up to 350m elevation in shrubland, secondary forest and plantations. Adults have primarily been seen nectaring at *D. erecta*; they are crepuscular. Reared on *P. scandens*, the whole life cycle taking five weeks to complete (D. Mohn, pers. comm.)
Similar species: see *M. poecilum*

Macroglossum poecilum Rothschild & Jordan 1903 (Figs. 9 & 13f)
Global distribution: China (including TW), Japan, N Vietnam, N Philippines, N. Borneo. H.K. distribution & status: local (northwest New Territories, central New Territories); scarce.
H.K. ecology: adult records from June, July, September, November and December, occurring in secondary forest up to 100m elevation. Reared from *Lasianthus chinensis* (Champ. ex Benth.) Benth. (Rubiaceae), the life cycle taking five to six weeks (Li, 1998).
Similar species: *M. neotroglodytus*, *M. insipida* – *M. insipida* and *M. neotroglodytus* are virtually inseparable in the field; in fresh specimens both have a purple sheen. *M. insipida* has a larger loop in the forewing postmedial fascia below the costa. *M. poecilum* (originally described as a subspecies of *M. insipida*) has a dark orbicular stigma in the forewing discal spot, the medial and postmedial fasciae almost meet below this stigma and the dark band between the medial and submedial fascia has a small light rectangular patch near the costa.

Macroglossum sitiene Walker 1856 (Figs. 7 & 13n)
Global distribution: north-eastern India, Sri Lanka, Maldives, Thailand, Vietnam, China (south, HK, TW), south Japan, Malaya, Sumatra, Philippines. H.K. distribution & status: widespread, uncommon.
H.K. ecology: multivoltine, adults recorded from January through March and August through December, occurring up to 200m elevation in shrubland, parks and feng shui woods. Mostly seen nectaring at *D. erecta*. Reared on *P. scandens* (Li, 1992), ova laid in late December eclosing in early March.
Similar species: see *M. pyrrhosticta*

Macroglossum heliophila Boisduval (1875) (Figs. 6 & 13h)
Global distribution: India, Thailand, Vietnam, China (TW, GD, HK, MC, HN), south Japan, Sundaland, Philippines, New Guinea, Australia (Queensland). H.K. distribution & status: widespread, common.
H.K. ecology: multivoltine, with records in March, April and June through December; occurring up to 450m elevation in secondary forest, feng shui woods, shrubland, parks and plantations. Recorded nectaring on *Zanthoxylum avicennae* (Lam.) DC. (Rutaceae) (Kendrick & Barretto, 2008), *Bidens pilosa* L. and *Sphagneticola trilobata* (L.C. Rich.) Pruski (=*Wedelia triloba* (L.) Hitchc.) (both Asteraceae). Larvae have been reared on *Psychotria asiatica* L. (Rubiaceae) (Bascombe & Young, in Tennent 1992; Li, 1992).
Similar species: see *M. pyrrhosticta*

Taxonomic notes: this taxon should currently be treated as a subspecies of *M. divergens* Walker 1856 (Beck & Kitching, 2010), rather than the other way round as listed by Kitching & Cadiou (2000). However, DNA analysis work currently being undertaken suggests the situation may yet change further (Kitching, pers. comm.). *Macroglossum d. divergens* was listed as endemic to Sri Lanka by Kitching & Cadiou (2000). Listed in Chu & Wang (1997) under the synonym *M. fringilla* Boisduval (1875).

Macroglossum pyrrhosticta Butler 1875 (Figs. 12, 13i & 13j)
Global distribution: eastern India, Sri Lanka, Thailand, Vietnam, China (FJ, TW, HK, MC), Korea, Japan, Sundaland, Philippines. [introduced: Hawaii]. H.K. distribution & status: widespread and common.
H.K. ecology: multivoltine, recorded in January, March, April and July through November, from secondary forest, feng shui woods, shrubland and parks up to 500m elevation; primarily found feeding at *D. erecta* and also at *Z. avicennae*. Larvae reared on *P. scandens* (Bascombe and Young, in Tennent, 1992; Li, 1992).
Similar species: *M. variegatum*, *M. sitiene*, *M. heliophila*, *M. glaucoptera*. *Macroglossum sitiene* can be separated from the rest of this group by the sub-basal fascia on the forewing, which contains a 90° to 100° sharp angle, turning and continuing to the base of the wing, about three-quarters of the way from the costa to the dorsum. In the other species this angle is replaced by a curve. *Macroglossum variegatum* has a grey-brown ventral thoracic and abdominal surface, this is reddish chestnut in *M. pyrrhosticta*; with black patches in worn specimens. *Macroglossum heliophila* usually has its forewing medial band

pale grey edged with distinct dark bands (rather than fasciae, as in *M. glaucoptera*) on either side and is green in overall tinge. *Macroglossum glaucoptera* has the darkest overall appearance, with the medial and post medial fasciae black; its hindwing normally has two orange-yellow basal patches, though these may be fused to form a narrow band; the thorax has less contrasting markings. The ventral surfaces of the abdomen and fantail of *M. pyrrhosticta* are a reddish chestnut colour, which often appear with worn, white rimmed patches centrally along the abdomen.

Macroglossum variegatum Rothschild & Jordan 1903 (Figs. 11, 13p & 13q)
Global distribution: east India, Thailand, Vietnam, China (FJ, GD, HK, HN), Malaya, Gtr. Sundas, Philippines. H.K. distribution & status: widespread, uncommon.
H.K. ecology: multivoltine, records of adults from April, June, late July to November, occurring in secondary forest, shrubland, parks and plantations up to 200m elevation, mostly recorded nectaring at *D. erecta* and also at *Z. avicennae.*
Similar species: see *M. pyrrhosticta*.

Macroglossum glaucoptera (Butler 1875) (Fig. 13g)
Global distribution: Sri Lanka, Thailand, Vietnam, Malaya, Sumatra, Java, Philippines, Sulawesi. H.K. distribution & status: restricted (Tuen Mun); rare.
H.K. ecology: one adult reported nectaring at *D. erecta*, June (Li, 1998), specimen deposited in KFBG.
Similar species: see *M. pyrrhosticta*.

Macroglossum saga (Butler 1878) (Figs. 3 & 13b)
Global distribution: north India, Nepal, Thailand, Vietnam, Peninsular Malaysia, China (GD, HK, BJ, TW), Japan. H.K. distribution & status: local (central New Territories, northeast New Territories); scarce.
H.K. ecology: adult records from January to March and October; found in agricultural land and secondary forest up to 340m elevation.
Notes: originally reported from Hong Kong by Kendrick (1998), though an earlier unpublished series of five records from Tai Lung Farm, Fanling (1992-1995) and Ho Pui (1993) in the AFCD collection has subsequently been identified.

Macroglossum fritzei Rothschild & Jordan 1903 (Fig. 13m)
Global distribution: Nepal, Thailand, southern Japan, China (HN, HK, GD, HuN, HuB, TW), Peninsular Malaysia, Borneo. H.K. distribution & status: widespread, common.
H.K. ecology: recorded throughout the year and probably continuously brooded, though peaks in abundance occur in April and October-November; found from sea level to 690m elevation in or close to secondary forest, feng shui woods and shrubland. Reared on *Morinda umbellata* L. (Rubiaceae), taking five weeks to complete its cycle (D. Mohn, pers. comm.). This is the only species of *Macroglossum* commonly taken at light traps.

Macroglossum sylvia Boisduval (1875)
Global distribution: north India, Sri Lanka, Thailand, Vietnam, China (HK, TW), Malaya, Gtr. Sundas, Philippines, Sulawesi.
H.K. distribution & status: Lantau Island (Tung Chung); rare.
H.K. ecology: one adult reported nectaring at *D. erecta*, October (Tennent, 1992).
Similar species: see *M. corythus*.

Macroglossum corythus Walker 1856 (Figs. 2 & 13e)
Global distribution: northeast India, Andaman Is., Thailand, Vietnam, China (HLJ, JL, LN, BJ, SD, JS, HuB, HuN, JX, FJ, GD, HN, GX), Sundaland, Wallacea, Philippines: other subspecies – Japan, Ryukyu Is., south India, Sri Lanka, Moluccas, New Guinea, Australia (Queensland), Tanimbar, Solomon Is., Bismarck Arch., New Caledonia, Loyalty Is.. H.K. distribution & status: widespread, common.
H.K. ecology: multivoltine, recorded from late February to the end of November, commonest in October; found up to 690m elevation in secondary forest, feng shui woods, shrubland, mangrove and urban parks. Mostly seen nectaring at *D. erecta* and also on *L. camara* and and also at *Z. avicennae*. Larvae have been reared on *P. scandens* (M. Bascombe, in Tennent, 1992; K. Li, pers. comm.).
Similar species: *M. sylvia* has a dark brown "tail fan" and abdomen (chestnut brown in *corythus*) with white patches ventrally, though this is not clear in greasy or worn specimens (Tennent, 1992).

Macroglossum passalus (Drury 1773) (Figs. 5 & 13c)
Global distribution: India, Sri Lanka, Thailand, China (HK, TW, SC), Ryukyu Is., Sumatra, Java, Borneo, Philippines. H.K. distribution & status: widespread, uncommon.
H.K. ecology: at least trivoltine, with adult records from mid-March to mid-May, July to early September and mid-November to mid-December. Found from 60m to 550m elevation in secondary forest, mostly seen nectaring at *D. erecta* and also regularly seen nectaring at *Plumbago indica* L. (Plumbaginaceae) in August 2008 (Barretto & Kendrick, 2008). Larvae have been reared (Bascombe, in Tennent 1992, Li 1992) on *Daphniphyllum calycinum* Benth. (Daphniphyllaceae), taking 26 days from 1st instar larva to eclosion in June-July (D. Mohn,

pers. comm.) and the October life cycle taking 26 days (N. Tong, via K. Li, pers. comm.).
Similar species: *Macroglossum faro* (Cramer, 1780) (which could occur in Hong Kong) is almost identical in external appearance, but substantially larger than *M. passalus*.

Macroglossum mitchellii Boisduval (1875) ssp. *imperator* Butler 1875 (Figs. 4 & 13a)
Global distribution: south & east India, Sri Lanka, Thailand, Vietnam, China (HK, YN, TW), Malaya, Sumatra, Borneo, Sulawesi: nominotypical subspecies – Java. H.K. distribution & status: restricted (CNT), rare.
H.K. ecology: records from late March to late May and October; most on hill-tops at light.
Similar species: see *M. mediovitta*.

Species not yet recorded from Hong Kong, but which might occur

Macroglossum aquila Boisduval 1875
Global distribution: northeastern India, Bangladesh, Thailand, southern China (GD, GX, HN), Vietnam, Malaya, Sumatra, Java, Borneo, Philippines (Luzon).
A small species, dark basal area to the forewing, which is otherwise rather plain, the medial, post-medial and subterminal fasciae fairly faint; a small white oblique discal spot near the medial fascia and costa; the h/w is similar to *M. heliophila,* but has a diagnostic lobe on the ventral side of the hindwing costal edge, not found in other *Macroglossum* species (I.J.Kitching, pers. comm.)

Macroglossum faro (Cramer 1780)
Global distribution: southern India, Thailand, Vietnam, China (GD), Ryukyu Is., Malaya, Sumatra, Java, Borneo.
Similar to *M. passalus*, though substantially larger at around 75mm wingspan and with unicolorous green thoracic tegulae (in *M. passalus*, the posterior half of the tegulae is dark slate grey).

Discussion

The number of records from which the data are derived is still relatively small, 688 individuals recorded by Tennent (1992), plus a further 460 records of occurrence collated by the author, thus extensions to the elevational ranges and records from other habitats must be expected in future. Similarly, there remains much work to be done to elucidate and illustrate the life histories of most *Macroglossum* species in Hong Kong in order to assess whether these fascinating moths require any specific conservation measures. Some of the species are evidently rarely encountered in Hong Kong (e.g. *M. mitchellii*, *M. bombylans*) and these species are reported to be rare elsewhere in their ranges (Pittaway & Kitching, 2000-2010). Several other species have been encountered only once or twice, and only more intensive recording will reveal whether these species are resident in Hong Kong, or vagrants from elsewhere within their distribution, which may well be the case for *M. stellatarum*, a known and well-documented migrant, or whether they have gone undetected due to their similarity to other species. Further information on the taxonomy, identification and ecology of all these species is available on-line from Pittaway & Kitching (2000-2010).

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Figure 13

Facing page:
Figure 13. Adults of *Macroglossum* species
a – *M. mitchellii;* b – *M. saga*; c – *M. passalus*; d – *M. mediovitta*; e – *M. corythus*; f – *M. poecilum*; g – *M. glaucoptera*; h – *M. heliophila* ; i – *M. pyrrhosticta;* j – *M. pyrrhosticta* (ventral); k – *M. belis*; l – *M. neotroglodytus* ; m – *M. fritzei*; n – *M. sitiene*; p – *M. variegatum*; q – *M. variegatum* (ventral).

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Everes argiades (Pallas 1771) a vagrant butterfly newly recorded in Hong Kong (Lepidoptera: Lycaenidae)

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Abstract
Material of a widespread temperate species, *Everes argiades*, was collected on Lantau Island in October 2009. However, judging from the distribution pattern and habit of the species, it is unlikely to establish in Hong Kong and therefore it is considered as a new vagrant record.

Key words: Lepidoptera, Lycaenidae, Polyommatini, *Everes argiades*, Hong Kong

Introduction
Everes Hübner, 1819 is a small Polyommatini genus composed of only five species and has a vast distributional range through Holarctic America, Europe and Asia to the Indo-Australian Region (Parsons, 1999; Tennent, 2002). Most members of the genus have an exclusively temperate distribution, with the only exception being *Everes lacturnus* (Godart 1824) which mainly occurs in tropical regions. *E. lacturnus* also occurs in Hong Kong and Bascombe et al. (1999) considered it as a common species.

During a biodiversity survey being conducted in Sha Lo Wan on Lantau Island, Hong Kong, two lycaenid ova were collected for immature biology study; surprisingly, a pair of unfamiliar *Everes* emerged from these eggs. After examining the specimens, the identity was confirmed to be *Everes argiades* (Pallas 1771), a species previously not known from Hong Kong.

Materials and methods
Samples of *Everes argiades* (2 males, 3 females) from Chongqing, central China were compared with the Hong Kong material. Genitalic illustrations in Shirozu (1960) and Gorbunov (2001) were used as supplementary references. Abdomens of one male Chongqing specimen and the Hong Kong male were placed in 10% NaOH for 24 hours to dissolve the soft tissue and then transferred to 75% ethyl alcohol for genitalia dissection under a 40x stereo microscope. Dissected genitalia were preserved in 75% ethyl alcohol and labelled. All specimens are deposited in the Y. F. Lo Collection, Hong Kong.

Taxonomic account
Everes argiades diporides Chapman 1909 (Figs. 1-4)
Voucher materials: 1 male (wings distorted), Hong Kong: Lantau Island, Sha Lo Wan, alt.10m, 06.x.2009, Coll. A. Chau, reared from *Indigofera hirsuta*, emgd. 03.xi.2009 (genitalia preparation: YFL ly0019). 1 female, same collecting data and host, emgd. 02.xi.2009.

Diagnosis of adult: The appearance of *E. argiades* resembles that of the congeneric species *E. lacturnus* which is a common butterfly in Hong Kong. However, the two species can be distinguished by comparing the underside of the hindwing. *E. argiades* has a shorter tail with black postdiscal spots while *E. lacturnus* has a longer tail with postdiscal spots grey in colour. Moreover, male *E. argiades* usually possesses a dark cell-end bar on the upperside of the forewing (Figs. 3 & 5). The male genitalia of *E. argiades* has a short pointed uncus (Fig. 6), whereas the uncus of male *E. lactumus* has a shallow concavity.

Discussion
E. argiades is primarily a temperate species that is distributed through most of the Palaearctic Region south of 60° N (Tolman & Lewington, 1997; Gorbunov, 2001), with some populations reaching the northern Oriental Region. Despite its small size and weak flight, *E. argiades* shows substantial dispersal ability and Tolman & Lewington (1997) reported it as a rare immigrant in England from the European continent. With the nearest known population found in Nanling, a mountain range in northern Guangdong, China (Chen, 1997), the occurrence of stray individuals in Hong Kong, a coastal city in southern China approximately 250km away from Nanling, is not unexpected.

However, even though breeding of *E. argiades* was observed at Sha Lo Wan, we predict that this species is unlikely to establish in Hong Kong. Colonies of *E. argiades* in Guangdong, India and Taiwan are all restricted to montane areas (Chen, 1997; Kehimkar, 2008; Yamanaka, 1980) and the Japanese race has never reached the Amami Islands (Shirozu, 2006). This distribution pattern reveals a strong temperate association for this species. Based on the definition of Hong Kong butterfly status suggested by Lo & Hui (2005), since Hong Kong is apparently outside the distribution range of *E. argiades*, we consider it as a new vagrant record for Hong Kong.

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Figures

Figure 1. Upperside of female *E.argiades* from Hong Kong.

Figure 2. Underside of female *E.argiades* from Hong Kong.

Figure 3. Right lateral view of Hong Kong male *E.argiades* (wings distorted), showing the dark cell-ended bar on upperside of left forewing.

Figure 4. Left lateral view of Hong Kong male *E.argiades* (wings distorted).

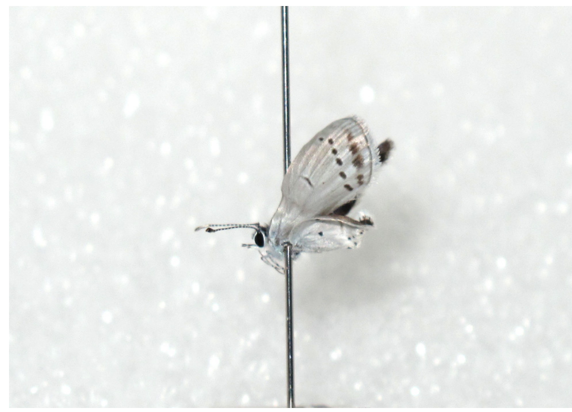

Figure 5. Upperside of male *E.argiades* from Chongqing, Central China.

Figure 6. Dorsal view of *E. argiades* male genitalia from Hong Kong. Scale bar: 0.5mm.

Seasonal emergence of dragonflies (Odonata: Anisoptera) at ten ponds in Hong Kong

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Abstract

Dragonfly emergence was monitored at ten ponds in Hong Kong, using emergence traps, for periods of varying duration between February 2004 and September 2007. Three newly created ponds, five re-profiled ponds and two long-established former commercial fish ponds were included in the study.

Exuviae abundance varied considerably between ponds and years, as did the number of species recorded. There was an overall declining trend over the four year period. The causes of these variations were not determined.

Dragonfly emergence was strongly seasonal in all four years, with > 80% of total annual emergence occurring in March to May in most ponds. A winter emergence peak, dominated by *Pantala flavescens*, was recorded in ponds which had only been filled in the preceding summer.

Key words: Odonata, dragonflies, Anisoptera, Hong Kong, exuviae, emergence, seasonality.

Introduction

Hong Kong has a strongly seasonal climate, dominated by alternating warm summer and cool winter monsoons (the 'wet' and 'dry' seasons), lasting from May to September, and November to February, respectively, with transitional periods in-between (Dudgeon & Corlett, 2004). The mean annual temperature is 22.8°C, with daily temperatures averaging 28.8°C in July, but in January (the coldest month), mean daily temperatures are 15.8°C, and the thermometer can occasionally drop to below 10°C for several days at a stretch between December and March, during strong pulses of the winter monsoon. Meanwhile, 77% of annual rain falls during the summer monsoon, with just 6% during the winter dry season. Not surprisingly, this marked seasonality is reflected in the annual adult emergence patterns of various terrestrial and aquatic insect groups in Hong Kong (Dudgeon & Corlett, 2004).

In the case of Odonata, it has long been known that certain stream species in Hong Kong are univoltine (e.g., Dudgeon, 1989a; 1989b) and have a narrow late spring / early summer emergence period coinciding with the onset of the wet season and rising temperatures, followed by a relatively short flight season. These 'spring species' include damselflies (Zygoptera) in the families Megapodagrionidae, Platycnemididae and Platystictidae, one species of Calopterygidae and, amongst Anisoptera, the riverine species of Gomphidae (15 species), and members of the genus *Macromia* (Corduliidae) (Wilson, 1995; 2004). When it comes to most species found in lentic habitats such as ponds and marshes, however, the picture is less clear. Many pond species in Hong Kong can be seen on the wing from March to January of the following year (Wilson, 2004). This extended flying period led Wilson (2004) to remark that "Timing of emergence does not follow a clear pattern for most [Hong Kong] species", although he also observed that most lentic habitat species have a peak emergence in spring and continue to emerge in lesser numbers until late autumn, an observation largely corroborated in a systematic study of emergence at one pond by Reels (2009).

Between February 2004 and September 2007, I obtained data on seasonal dragonfly emergence while monitoring dragonflies at 10 different ponds situated on land owned by the Kowloon-Canton Railway Corporation – later amalgamated with the Mass Transit Railway Corporation (MTRC) – in the northwest New Territories, Hong Kong. As noted by Moore & Corbet (1990), regular exuviae counts throughout the emergence period are the best method for monitoring dragonfly (Odonata: Anisoptera) populations at a specific pond, and this can be effectively achieved by the use of dragonfly emergence supports that can increase the likelihood of finding exuviae and provide a standardized method of collection. Replicated emergence traps can permit meaningful comparisons of numbers of emerging dragonflies, per pond or per unit area (Payne, 2003), while also yielding useful information on seasonality of emergence. This paper focuses on the general seasonality of overall dragonfly emergence in the 10 study ponds, with remarks on variations between ponds and years.

Methods

Monitoring of dragonfly emergence, using standardized exuviae traps, was conducted at two newly created (in 2003) ponds near Kam Tin, and eight former commercial fish ponds or newly excavated ponds at Lok Ma Chau, on land owned by MTRC and managed by Asia Ecological Consultants (AEC), for varying lengths of time during 2004 to 2007.

The traps presented an enclosed space in which emerging dragonfly adults were trapped, and were based upon a design first used by Cook & Horn (1968). Traps were open at the bottom and at one side, with the top measuring 60cm x 60cm and the sides measuring 30cm high. They were placed at the shoreline, initially with the open side submerged so that

dragonflies emerging within the traps were unable to fly out. Payne (2003) monitored dragonfly emergence from 26 small lakes in Washington, USA, using six traps per lake. In the current study, eight such traps were deployed in each study pond, with the exception of the tiny Pond 5, in which only four traps were deployed.

An exuviae trap in Pond 4

Owing to the fluctuating water levels in each pond (resulting from either evaporation, prolonged heavy rain or habitat management activities), emergence apparatus were regularly moved up or down the shore in order to maintain their position at the water margin. Hence the habitat in which each individual trap was situated could, over the course of the study period, vary from emergent macrophytes, to submerged macrophytes (in ponds where this habitat existed), to unvegetated mud. An effort was made to ensure that all available larval habitats at the pond margins at a given time were represented in the siting strategy for the emergence apparatus, with approximately equal representation for the north-, south- east- and west-facing aspects of each pond.

Exuvia of Epophthalmia elegans (Corduliidae) on emergence trap

Reels (2009) determined that mean persistence of Anisoptera exuviae in the field was 3.4 days (n = 45 exuviae, from five species, during the early wet season). Thus, in all ponds, exuviae on the inside and outside of each trap were collected, identified and counted every three or four days (occasionally, longer periods between collections were unavoidable).

Exuviae were subsequently identified with the aid of a dissecting microscope, using keys and illustrations provided by Zhou (1994), supplemented by various Japanese texts (Kawai, 1985; Ishida, 1996; Sugimura et al., 2001). Further confirmation of exuviae identifications was made in many cases by association with teneral adults, either when the latter had failed to completely emerge from the exuviae, or when found alongside their exuviae in emergence traps.

Table 1 gives information on the size, location and vegetational attributes of the 10 study ponds, as well as a summary of the exuviae sampling effort in each pond over the period February 2004 to November 2007.

Exuvia of Orthetrum sabina (Libellulidae) on emergence trap

Results

Emergence trends in ponds and years

Total numbers of exuviae and species emerging per pond in each year are summarised in Table 2. Exuviae abundance was generally highest in Pond 4 (apart from in 2007, when, surprisingly, zero exuviae were recorded in this pond). The highest number of species recorded emerging in any pond was 12, in Pond 3 in 2004. Annual differences in dragonfly emergence within ponds were clearly seen in Ponds 2, 4, 5 and 6, all of which were monitored for exuviae abundance from 2004 to 2007. In all four of these ponds, exuviae abundance had declined to negligible numbers by 2007. In Ponds 2, 5 and 6, this decline was progressive over the study period, whereas in Pond 4 there was a significant recovery in 2006 (followed by zero exuviae in 2007).

Table 1. The study ponds

Pond	Site	Position	Area (ha)	Trapping history	Physical attributes
1	Kam Tin	22°26’40.8”N, 114°03’19.2”E	1.4	Eight traps set February 2004; removed March 2005.	A large, newly-created (2003) pond without floating or submerged macrophytes. Emergent vegetation comprising sedges, rushes, grass and reed.
2	Kam Tin	22°26’28.7”N, 114°03’31.7”E	0.4	Eight traps set from March 2004 to September 2005; Mar-Sep 2006; Mar-Nov 2007.	A small, newly-created (2003) pond with floating and emergent macrophytes. Briefly drained late May 2004. Water level fluctuated widely over the four years.
3	Lok Ma Chau	22°30’35.7”N, 114°03’40.7”E	1.2	Eight traps set from Feb-Oct 2004. Traps completely inundated in October 2004.	A large, shallow (max. depth ca 1m) former fish pond, with extensive growth of emergent grass, and reeds at the southern end.
4	Lok Ma Chau	22°30’35.9”N, 114°03’46.2”E	1.2	Eight traps set February 2004 to September 2005; Mar-Sep 2006; Mar-Sep 2007. Temporarily removed 27 May to 19 July 2004 due to partial draining activities; traps completely submerged throughout October 2004.	A large, long-established, relatively deep fish pond (max. depth >1.5m), lacking floating or submerged macrophytes. Emergent vegetation along the pond margin comprised entirely of *Panicum* grass. Open water > 99% of the pond area.
5	Lok Ma Chau	22°30’33.5”N, 114°03’46.7”E	<0.1	Eight traps set November 2004 to January 2005; reduced to four traps Feb-Sep 2005; Mar-Sep 2006; Mar-Sep 2007.	A very small, shallow, newly excavated pond, planted with sedge and reed and with emergent grass around the margin.
6	Lok Ma Chau	22°30’39.4”N, 114°03’52.7”E	0.7	Eight traps set from November 2004 to September 2005; Mar-Sep 2006; Mar-Sep 2007.	A shallow, medium-sized marshy pond established late summer 2004 with rooted submerged macro-phytes, sedge and reed.
7	Lok Ma Chau	22°30’47.1”N, 114°03’52.5”E	0.3	Eight traps set Mar-Sep 2006; Mar-Sep 2007.	A small, shallow marshy pond, established by late 2005, with rooted submerged macrophytes and sedge.
8	Lok Ma Chau	22°30’48.0”N, 114°03’58.0”E	0.6	Eight traps set September 2006 to September 2007.	A medium-sized pond, newly planted with lotus and with short emergent grass at the margin.
9	Lok Ma Chau	22°30’45.8”N, 114°03’58.8”E	0.6	Eight traps set Mar-Sep 2007.	A medium-sized pond, newly planted with lotus and with short emergent grass at the margin, established by late 2006.
10	Lok Ma Chau	22°30’48.4”N, 114°04’02.0”E	0.4	Eight traps set Mar-Sep 2007.	A small pond, newly planted with rooted submerged macrophytes and with short emergent grass at the margin, established by late 2006.

Pond 1, 2004-2005

Exuviae abundance was extremely low in this pond (Figure 1), with just eight exuviae of a single species, *Ictinogomphus pertinax*, recorded on the traps. Four of these were collected in May 2004, two in June and two in July. No exuviae were recorded from August 2004 to March 2005, after which the study was terminated in this pond due to a water buffalo destroying all the apparatus.

Pond 2, 2004-2007

Eight species of Anisoptera were recorded as exuviae in Pond 2 in 2004, and 204 exuviae were collected. 33% of overall dragonfly emergence (Mar-Dec) was in April, 37% in May and 18% in June. Exuviae were recorded in considerably lower numbers in March, July, August, November and December (Fig. 1). In Jan-Sep 2005, 143 exuviae (of totally six species) were collected, 43% of which occurred in April, and 50% in May.

Only single exuviae were found in June and July, and none at all Aug-Sep (Fig. 2). In Mar-Sep 2006, 111 exuviae (of six species) were collected. 41% were collected in March, 56% in April, and none after July (Fig. 3). In Mar-Nov 2007, only a single exuviae was collected, in April.

Table 2. Annual emergence per pond

Pond	Exuviae abundance (species)			
	2004	2005	2006	2007
1	8 (1)	-	-	-
2	204 (8)	142 (6)	111 (6)	1 (1)
3	125 (12)	-	-	-
4	504 (6)	133 (8)	402 (8)	0 (0)
5	113 (2)	53 (9)	12 (6)	2 (1)
6	104 (1)	201 (9)	9 (6)	4 (4)
7	-	-	17 (3)	10 (7)
8	-	-	180 (4)	264 (8)
9	-	-	-	534 (9)
10	-	-	-	30 (7)

Pond 1

Pond 2

Pond 3, 2004

Totally 125 exuviae (from 12 species) were collected in 2004. 18% were in March, 50% in April and 19% in May. No exuviae were recorded in February or in Sep-Oct (although rising water levels had submerged the traps by October) (Fig. 1).

Pond 4, 2004-2007

Totally 504 exuviae (from six species) were recorded in 2004, with 34% of overall dragonfly emergence in March, 45% in April and 18% in May. No exuviae were recorded in February, June (when monitoring was suspended), and Sep-Oct (when traps were inundated). Totals of three and two exuviae, respectively, were recorded in November and December (Fig. 1). In Jan-Sep 2005, 133 exuviae were collected (eight species). 50% of all emergence occurred in April, and 32% in May. No exuviae were recorded Jan-Feb, and only two in September (Fig. 2). In Mar-Sep 2006, 402 exuviae (from eight species) were collected. Exuviae were collected in every month, but Apr-May was the peak emergence period, with 53% in April and 21% in May. 10% of overall recorded emergence occurred in March (Fig. 3). In Mar-Sep 2007, no exuviae were recorded.

Pond 4

Pond 5, 2004-2007

A relatively large number of exuviae (113) were recorded in Nov-Dec 2004 (Fig. 1), dominated by the libellulid *Pantala flavescens* (111 exuviae) – a pioneer species, able to fly immense distances with seasonal rains, and known to have a very rapid larval development (Corbet, 1999; 219; Suhling et al., 2009) which would allow maturation of larvae from eggs deposited in the pond in mid-summer 2004, when the pond was first established. In Jan-Sep 2005, 53 exuviae (from nine species) were collected. 28% of all emergence was in January (a continuation of the *P. flavescens* emergence of Nov-Dec 2004). 11% of emergence was in March, 36% in April, and 21% in May. No exuviae were collected in February, and only two in Jun-Sep (Fig. 2). In Mar-Sep 2006, emergence was much lower (12 exuviae from six species). 50% of exuviae were recorded in April, none in March, and the remaining 50% spread

Pond 5

across May-Sep (Fig. 3). In Mar-Sep 2007, only two exuviae were recorded, in March.

Pond 6, 2004-2007

As in Pond 5, a relatively large number of *P. flavescens* exuviae (104) were recorded in Nov-Dec 2004 (Fig. 1), representing the first colonisers of the pond. Subsequently, in Jan-Sep 2005, 201 exuviae (from nine species) were recorded. 11% of these were in March, 65% in April and 19% in May. No exuviae were recorded after August (Fig. 2). In Mar-Sep 2006, only 9 exuviae were collected (six species). Three of these (33%) were in April; the remainder were scattered in March and Jun-Sep (Fig. 3). In Mar-Sep 2007, only four exuviae were collected (four species); two in March and two in April.

Pond 6

Pond 7, 2006-2007

Totally 17 exuviae, from three species, were collected Mar-Sep 2006. Eight exuviae (47%) were in April; five (29%) in May. No exuviae were recorded after June (Fig. 3). In Mar-Sep 2007, 10 exuviae (from seven species) were collected, all in the period Mar-May (Fig. 4).

Pond 8, 2006-2007

In Sep-Dec 2006, 180 exuviae (from four species) were collected; 29% in September, 32% in October, 35% in November and 4% in December (Fig. 3). This late emergence followed summer filling of the pond, and more than half the exuviae collected (103) were of *P. flavescens*. In Jan-Sep 2007, 264 exuviae were collected (eight species). 38% were in March, 40% in April and 13% in May. No exuviae were recorded in January or Aug-Sep (Fig. 4).

Pond 9, 2007

Totally 534 exuviae were collected (nine species). 31% were in March, 49% in April and 12% in May. No exuviae were recorded in Aug-Sep (Fig. 4).

Pond 10, 2007

Totally 30 exuviae were collected (seven species). 63% were in April and 27% in May. No exuviae were recorded in Aug-Sep (Fig. 4).

Figure 1. Dragonfly exuviae abundance, 2004

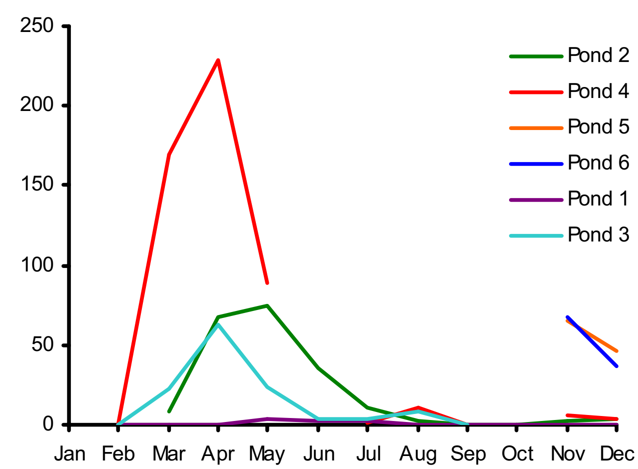


Figure 2. Dragonfly exuviae abundance, 2005

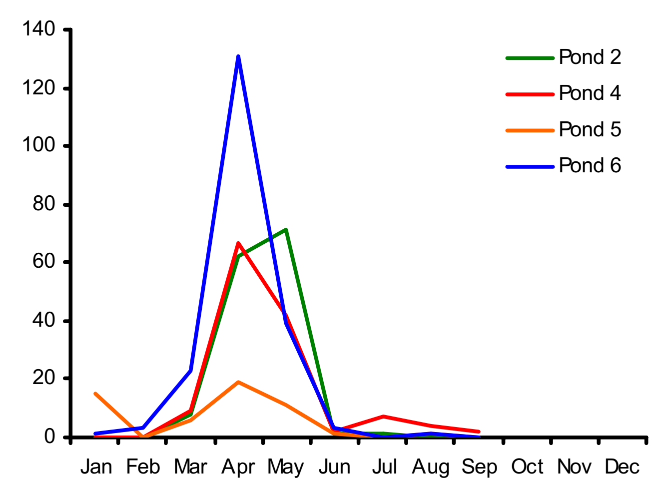


Figure 3. Dragonfly exuviae abundance, 2006

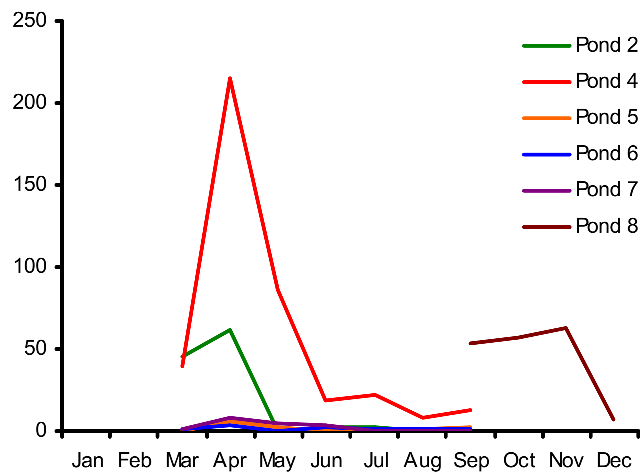
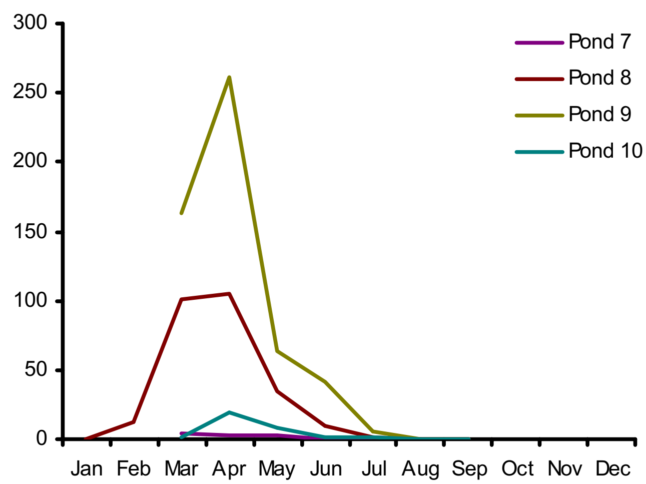


Figure 4. Dragonfly exuviae abundance, 2007



Species

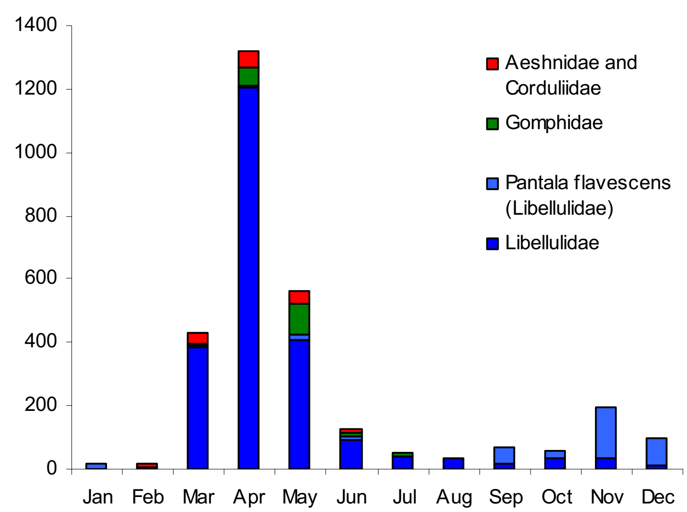
A total of 16 species of Anisoptera was recorded emerging on exuviae traps, across all ponds, over the four years. These included three species of Aeshnidae, two gomphids, one corduliid and 10 species of Libellulidae. Libellulids accounted for > 90% of exuviae abundance in 2004, 2006 and 2007, but in 2005 large anisopterans in the families Aeshnidae, Gomphidae and Corduliidae comprised more than a third of all exuviae collected (Table 3). Of the 16 species, 11 were recorded in all four years, one in three years, one in two years, and three in one year only. In 2004-2006, *Brachythemis contaminata* was by far the most commonly encountered species (particularly abundant in Pond 4), while *Orthetrum sabina* and *Diplacodes trivialis* comprised more than 80% of all exuviae collected in 2007. *O. sabina* numbers were relatively stable, as a proportion of all exuviae, across the four years, whereas the annual proportional representation of the majority of species fluctuated widely, usually over an order of magnitude.

General pattern of emergence

Dragonfly emergence, in terms of total number of exuviae of all species, was strongly seasonal in the majority of ponds, with a March-May peak (usually exceeding 80% of recorded emergence) seen in all four years. Typically, maximum monthly emergence was in April (sometimes exceeding 50% of total recorded annual emergence); less frequently it was in May or March. The data from all ten ponds over all four years is amalgamated in Fig. 5 to give a broad annual emergence pattern.

In general, the spring peak was followed by a rapid decline in emergence over the summer months, dwindling to zero or negligible emergence by September (Figs. 1-4). In three newly filled ponds (Ponds 5 and 6 in 2004, and Pond 8 in 2006), however, a significant winter emergence was observed (Figs. 1 and 3). It is noteworthy that in two of these cases (Pond 5 in Nov 2004 to Jan 2005, and Pond 6 in Nov-Dec 2004), the migratory libellulid *Pantala flavescens* comprised 98% and 100%, respectively, of exuviae collected, while in Pond 8 in Sep-Dec 2006 it comprised 57%. Libellulids in general were numerically dominant, while the proportion of exuviae of large-bodied anisopterans in the families Aeshnidae, Gomphidae and Corduliidae reached 26-28% in May, June and July. Over 50% of all exuviae collected in February were of the aeshnid *Anax parthenope*, emerging early in 2007 in Pond 21.

Figure 5. Exuviae abundance by family, summed for all years and ponds



Discussion

The eight exuviae traps in each pond (four in Pond 5) could only sample a very small portion of the margin and, in most cases, were not deployed during the period October to February, meaning that there is limited hard data for emergence over the cool dry season. Nevertheless the standardized approach makes it possible to discern broad trends in emergence across the various study ponds. Moreover, it seemed reasonable to assume from my own extensive field observations and from

Table 3. Species emerging on exuviae traps: % of annual emergence, 2004-2007

Species	2004	2005	2006	2007
Aeshnidae				
Anaciaeschna jaspidea (Burmeister)	0.2			
Anax guttatus (Burmeister)	0.2	1.5	0.5	2
Anax parthenope (Brauer)	1.5	7.4	0.4	3.7
Gomphidae				
Ictinogomphus pertinax (Hagen in Selys)	2.8	9.5	1	0.6
Sinictinogomphus clavatus (Fabricius)		14.6	1.9	
Corduliidae				
Epophthalmia elegans (Brauer)	0.8	1.1	0.1	0.5
Libellulidae				
Brachydiplax chalybea Ris	3.6	0.2	0.1	0.2
Brachythemis contaminata (Fabricius)	50.8	24.7	48.2	2.7
Crocothemis servilia (Drury)	2.7	15.3	1.9	0.6
Diplacodes trivialis (Rambur)	0.2	1.1	2.3	39.1
Orthetrum sabina (Drury)	13.5	17.8	28.9	41.5
Pantala flavescens (Fabricius)	21.1	4	14.4	3.6
Rhyothemis variegata (Drury)	0.2	0.2	0.3	0.9
Tholymis tillarga (Fabricius)	1.1			
Tramea virginia (Rambur)	0.8	2.6		4.6
Zyxomma petiolatum Rambur	0.5			
Total (actual number)	100 (1058)	100 (529)	100 (731)	100 (845)
Number of species	15	13	12	12

remarks made by Wilson (1995; 2004) that dragonfly emergence is typically negligible over the cool dry season (except under special circumstances; see below). As further corroboration of this, Reels (2009) made a comprehensive study of dragonfly emergence at one small Hong Kong pond over 17 consecutive months, and recorded no exuviae whatsoever between 8 September 2004 and 28 February 2005.

Different ponds, different years

As noted by Payne (2003), dragonfly populations in ponds are known to be very dynamic: a single pond may produce large numbers of dragonflies, but emergence is extremely variable among ponds and years. Overall exuviae abundance varied considerably between ponds in the current study, seemingly irrespective of pond size and vegetation profile. For example, the very large, open water Pond 1 had a variety of emergent vegetation, including stands of rushes and reeds as well as sedge and grass, yet only eight exuviae (of a single species) were collected during uninterrupted trapping over the period February 2004 to March 2005. In the same period, the similar-sized Pond 4, with marginal emergent vegetation entirely comprising *Panicum* grass, yielded more than 500 exuviae (of six species, albeit dominated by the libellulid *Brachythemis contaminata*). In 2007, Pond 9 yielded more than double the number of exuviae of the adjacent, similar-sized and similarly vegetated Pond 8. Certain species were apparently limited to only a very few ponds; for example *Epophthalmia elegans* only in Ponds 2, 4, 6 and 10, and *Sinictinogomphus clavatus* in Ponds 2 and 4. Three species (*Anaciaeschna jaspidea*, *Tholymis tillarga* and *Zyxomma petiolatum*) occurred in Pond 3 and nowhere else. These differences are difficult to explain with the available data.

With regard to the overall progressive decline in abundance of exuviae, year on year, this may have been due to an increasing predation impact from the growth and proliferation of predatory fish, as previously suggested for another small pond in Kam Tin (Reels, 2009). However there are a number of other variables at work (for example, a rapid proliferation of exotic *Pomacea* apple snails in Pond 2 over the same period) and it was unfortunately beyond the scope of this study to rigorously identify the causes, and eliminate the confounding variables, of these annual variations.

Clear seasonality

In spite of the large inter-year and inter-pond variations in exuviae abundance and species composition, there was a consistent seasonal trend in overall dragonfly emergence. As noted above, the period March to May is a transitional period in Hong Kong between the end of the cool, dry northeast monsoon and onset of the warm, wet southwest monsoon. The period sees steadily rising water temperature, which presumably acts as an important trigger for final instar anisopteran larvae to commence metamorphosis, leave the water and emerge as adults (other 'triggers' might include rising air temperature, humidity and increasing day length) (Corbet, 1999, 234-246; Dudgeon &

Corlett, 2004, Ch. 4). A migratory species such as *Pantala flavescens* (swarms of which move over large distances within the intertropical convergence zone) can, however, buck this general emergence trend, and winter emergence of this species is not unexpected, given the arrival of so many late summer *Pantala* on autumn typhoons around late September to October from the south (maybe from the Philippines; Keith Wilson, pers. comm.). The rapid larval development of this opportunistic coloniser, combined with the initial lack of large predatory fish in the new ponds, presumably facilitated this species' late autumn / winter emergence mass emergences in Ponds 5, 6 and 8.

Given that the adult flying season of lentic habitat anisopterans in Hong Kong commonly extends to December and beyond (Wilson, 1995, 2004; Cheung, 2008; Reels, unpublished observations), it appears likely that such dragonflies are capable of surviving as adults for several months. The very consistent Mar-May emergence period (containing sometimes in excess of 90% of a year's emergence), witnessed at a variety of ponds over up to four consecutive years, is nevertheless rather surprising for a 'tropical' location, and is perhaps more typical of emergence patterns of 'spring' species in temperate latitudes (Corbet, 1999; 244-248). Hong Kong's cool winters and latitude at 22ºN, however, mean that the climate is 'subtropical', rather than tropical. As summarized by Corbet (1999): "In subtropical latitudes, a generation of a tropical [odonate] species can last two and one-half times as long during the colder season, thus foreshadowing the overwintering patterns found in temperate-centred dragonflies".

Acknowledgements

I am grateful to MTRC for permitting the use of exuviae traps (a previously untested method in Hong Kong) in its mitigation wetlands at Lok Ma Chau and Kam Tin, and for granting me permission to publish this paper. AEC, to whom I was subcontracted during the study period, actively supported the work, constructing the apparatus and providing logistical back-up in the field. In 2004-2006, Moni Chin, Ying Hak-king and Elizabeth Wu of AEC assisted in collecting exuviae during my occasional absences from Hong Kong. During 2007, exuviae were regularly collected from the traps by Lindy Tam and Philip Yip of AEC. Dennis Paulson offered valuable advice and information prior to the commencement of the study. Bert Orr and Keith Wilson kindly reviewed and made useful comments on an earlier draft of this manuscript.

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Records of rose chafers (Coleoptera, Cetoniinae) in Hong Kong
香港的花金龜紀錄

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Abstract

Fourteen species of rose chafers (Coleoptera, Cetoniinae) from Hong Kong are listed with brief description and illustrations, of which three are new records, namely *Campsiura javanica* (Gory & Percheron, 1833), *Cosmiomorpha setulosa* Westwood, 1854 and *Clinteria ducalis* White, 1856. Information on distribution, flying periods, adult foods and immature stages are also provided whenever available.

Key words: Cetoniidae, Cetoniinae, beetles, Hong Kong, new records.

Introduction

Fabricius (1775) is the first author to have used the name *Cetonia*, while the family Cetoniidae was first proposed by MacLecy (1819). Some authors regard cetoniid beetles as belonging to the subfamily Cetoniinae of Scarabaeidae (Arrow 1910, Schenkling 1921, Medvedev, 1964 and Miksic 19867). However, Krikken (1984) insists Cetoniidae is a separate family and contains three subfamilies, namely Cetoniinae, Trichiinae and Valginae, while Ma (1995) treats Cetoniidae, Trichiidae and Valgidae as separate families. All records mentioned in this article belong to the Cetoniinae as defined by Krikken, or Cetoniidae as defined by Ma and the classification adopted in this article is that of Krikken (1994).

Cetoniid beetles are commonly called rose chafers, flower chafers or flower beetles. There are about 3,600 species of described cetoniid beetles in the world (Krikken, 1984), about 90% of which are Cetoniinae (Ma, 1995). Forty-two genera and 142 species of Cetoniinae are known in China (Ma, 1995). There are only fragmentary records of the subfamily in Hong Kong. Boheman described the first flower chafer (*Glycyphana nasalis*) from Hong Kong in 1858. Redtenbacher reported the second (*Gametis jucunda* (Faldermann 1835)) in 1867. Waterhouse reported the third (*Euselates schoenfeldti* Kraatz 1893) in 1900. Hill (1978, 1982) reported four additional species. Lee and Winney (1981) listed three species which overlap with Hill' s report. Yiu (2006) reported four species, of which two were new records for Hong Kong.

Methods

Since 2004, specimens of adult Cetoniinae have been collected in Hong Kong by the author. Cetoniinae could be readily collected on flowers and fruits where they feed. Sometimes, they are found feeding on sap exuding from trees. *Agestrata orichalca* (Linnaeus 1769) is attracted to artificial light and can be found in remote public toilets. Larvae of *Campsiura javanica* (Gory & Percheron 1833) were collected in cow dung and kept in captivity until they emerged. Adults of this species can also be found in cow dung. *Cosmiomorpha setulosa* Westwood 1854 is found on the ground and leaf litter of dense woodland.

Morphological features of the specimens were examined under a 20X-40X dissecting microscope for species which could not be identified with certainty in the field. Clear photographic records were also accepted. Specimens stored in Tai Lung Experimental Station of the Agricultural, Fisheries and Conservation Department were also examined. Records from old literature are also included as a reference. Chinese names adopted from Ma (1995) are added for Chinese readers.

The species

Cremastocheilini 顏花金龜族

1. *Campsiura javanica* (Gory & Percheron 1833)
   黑斑臀花金龜

Body length 15-18mm, black, with the head, pronotum and forelegs partially or entirely orange; the scutellum, side pieces of the metasternum and sides of the hind coxae generally bright yellow or (almost white in living specimens), and the sides of the third and fourth abdominal segments deep red. The pronotum commonly has a black median line and a large black patch laterally, the former may be reduced to a patch and the latter frequently reduced to two spots. Clypeus slightly convex. The pygidium bears a median longitudinal carina and a blunt tubercle laterally. The sternal process is very short and rather broadly dilated.

This is a new record for Hong Kong. Three last instar larvae were collected in cow dung in Chuen Lung in early May 2006. They fed on the cow dung and pupated a week after, using the cow dung and soil to build their pupal cases. They emerged in early June of the same year. Two additional records were made, one from Kap Lung in early March 2007 and the other from Chuen Long in March 2009. In both cases the specimens were found in or under cow dung.

Fig. 1.1 *Campsiura javanica* - last instar larva

Fig. 1.2 *Campsiura javanica* - pupa in a pupal case

Fig. 1.3 *Campsiura javanica* - ventral view

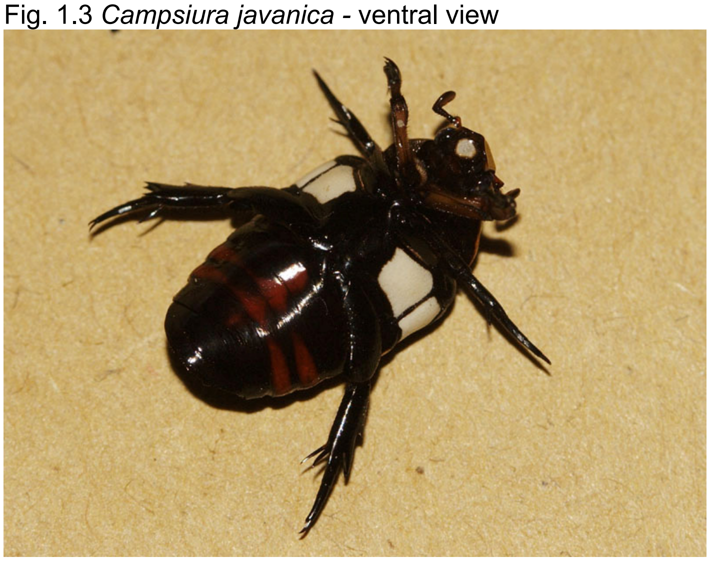


Fig. 1.4 *Campsiura javanica* - dorsal view

Fig 1.5 *Campsiura javanica* - variation of markings on pronotum

2. *Coenochilus striatus* Westwood 1874 條紋普花金龜

Original English description by Westwood: "The front margin of the clypeus is slightly emarginate; the maxillae have both the mando and galea armed with two nearly equal thick teeth; the mentum is subquadrate in its outline, but the middle of the disc is strongly angulated; the obliquely truncate anterior portion semicircular, and fringed with strong setae. The exposed part of the epimera. with a large patch on each side of the metasternum, and a spot on each side of the second and third segments of the abdomen, those on the third being smaller than the others. The under side of the abdomen is not longitudinally channelled at the base, and the anterior tibiae are obtusely bidentate." Type collected by Bowring from Hong Kong. No further local records since the type description.

Schizorhinini (未有中文名稱)

3. *Thaumastopeus nigritus* (Frolich 1792) 暗藍花金龜
Body length 30-31mm, elongated, dorsally flattened, straight-sided and slightly tapering from humeri to apex. Shining black, more or less tinged with blue. The clypeus is deeply cleft. Pronotum strongly extended posteriorly and covers the scutellum. Sternal process is slender and curved upward.

Occasionally recorded in various places including Wang Chau (Yuen Long), Kam Tin, Tai Lam and Fung Yuen. Often found feeding on ripe fruits such as longan (*Euphoria longana*) and figs (*Ficus* spp.).

Thaumastopeus pullus Billb. listed by Lee & Winney (1981), and *Thaumastopeus pullus* Fairmaire, 1891 are both synonyms of *Thaumastopeus nigritus* (Frolich, 1792)

The author's specimens also match well with the description of *T. shangaicus* by Neervoort Van De Poll J.R.H. (1886), who wrote: "I found two male specimens of this species in Chevrolat's collection, labelled 'Shanghai, Bowring'"; Wallace has also enumerated examples of the same locality for *T. pullus*, and he rightly remarks, "The Hongkong specimens are very fine and glossy, with the punctation of the elytra almost entirely wanting. Although very closely allied *to Th. pullus* Billb., *Th. anthracina* Wied. and *Th. cupripres* Waterh., this species differs from all these by its slender form, short thorax and strong apical callus; moreover *pullus* has the elytra rather deeply punctate-striate...". However, Neervoort Van De Poll's viewpoint on distinguishing *T. shangaicus* and *T. pullus* has probably not been noticed or accepted by later authors including Arrow (1910) and Ma (1995). Wallace (1868) considered the difference on elytra surface as a variation. He wrote: "The forms … vary much in size and colour… Some of the small Indian specimens … have elytra very much punctured, and there seems to be every form between these extremes…". Further study and dissection of genitalia would be helpful in resolving this issue.

Fig. 3.1 *Thaumastopeus nigritus* - feeding on longan fruits

Fig. 3.2 *Thaumastopeus nigritus* - deeply cleft clypeus

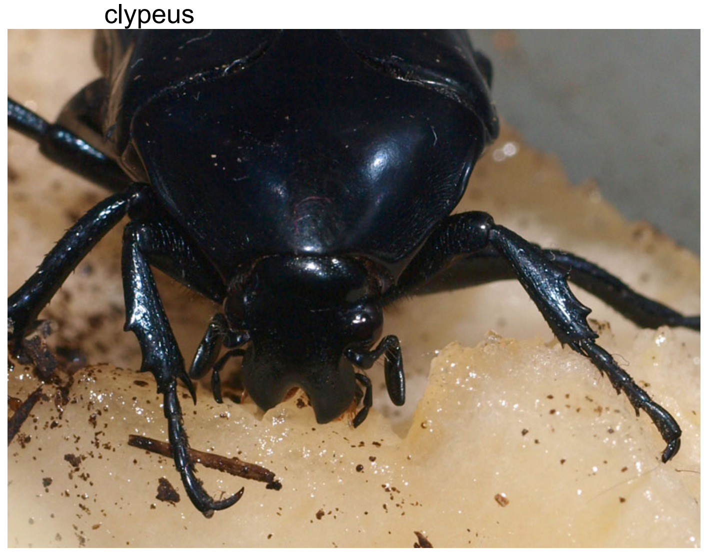


Fig. 3.3 *Thaumastopeus nigritus* - lateral view showing the sternal process

4. *Agestrata orichalca* (Linnaeus 1769) 綠奇花金龜
Body length 36 - 45.5mm, very flat. All local specimens exceed 40mm long. Largest scarab beetle in Hong Kong. Dorsal surface metallic dark green, very glossy. Coxae, femora, mesosternal epimera, pygidium and sides of the sternum and abdomen orange-red. Clypeus quadrate, anterior margin slightly concave.

The first documented record is probably by Hill & Cheung (1978). Recorded from May to September in 2007 and 2008, in Cheung Sha (Lantau), Nam Chung, Sai Wan (Sai Kung), Wong Cheuk Yeung and Tai Mo Shan. Feeds on various fruits in captivity. Attracted to artificial light at night.

Fig. 4.1 *Agestrata orichalca* - dorsal view

Fig. 4.2 *Agestrata orichalca* — ventral view

Fig. 4.3 *Agestrata orichalca* - clypeus and pronotum

Goliathini 巨花金龜族

5. *Dicranocephalus wallichi bowringi* Pascoe 1863
黄粉鹿花金龜
According to the descriptions by Pascoe (1863) and Ma (1995), the species has a body length of 19-25mm. Surface yellowish green; the clypeus, two longitudinal carinae on the pronotum, carinae on humera and apex of each elytron reddish. The clypeus of the male deeply depressed dorsally, the sides produced forwards into a pair of long and flattened slender horns. That of the female is only sharply angular on each side. Hua (2002) includes Hong Kong under its distribution range (source not indicated).

It is sometimes mis-spelt by some authors as *Dicronocephalus,* originating from a typographical error by Hope (1837). The spelling is clearly *Dicranocephalus* in Hope's original description of this genus in 1831.

6. *Cosmiomorpha setulosa* Westwood 1854
鈍鱗毛花金龜
Body length 13.5-16.5mm, yellowish brown or dark brown, densely punctured and clothed with yellow scaly hairs. Clypeus quadrate, anterior margin elevated. Scutellum nearly glabrous except at the basal corners. Each elytron has two longitudinal carinae.

A new record for Hong Kong: Ng Tung Chai (21.vi.2007, 11.vii.2009), moving on the dense woodland floor, at 2100h and 1500h respectively.

Fig. 6.1 *Cosmiomorpha setulosa* - dorsal view

Fig. 6.2 *Cosmiomorpha setulosa* - clypeus and pronotum

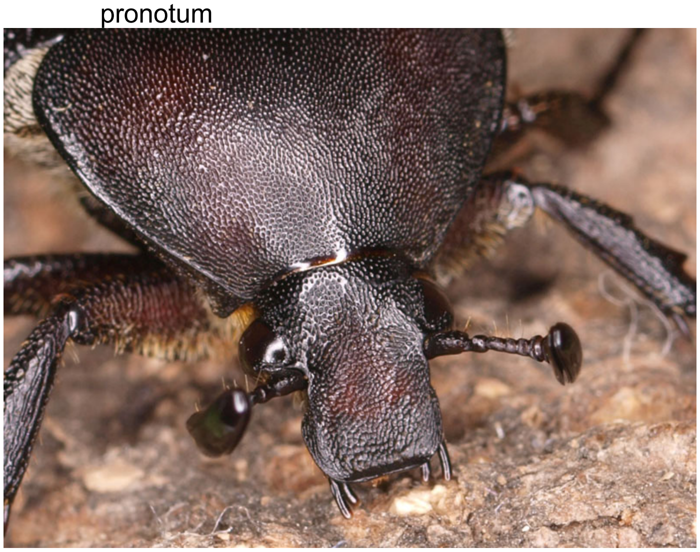


Fig. 6.3 *Cosmiomorpha setulosa* - lateral view

Cetoniini 花金龜族

7. *Protaetia orientalis* Gory & Percheron 1833
白點星花金龜

Body length 19-26mm, metallic green, golden-green, coppery or coppery-purple dorsally and ventrally, with a very narrow white marginal line on each side of the pronotum and small scattered white markings, consisting of four to seven small spots on each side of the pronotum, numerous indefinite spots near the lateral margins of the elytra, transverse median, postmedian and apical bars on each elytron, three spots (sometimes coalescing) on each side of the pygidium, numerous spots at the sides of the sternum, and transverse bars at the sides of the ventral segments. The head is coarsely and closely punctured and the clypeus quadrate, with the anterior margin strongly elevated and distinctly bilobed. The pronotum is coarsely but not closely punctured, except near the sides. The elytra are irregularly sculptured with large transverse punctures or impressions, the apical angles acute but not spinose. The pygidium, sides of the metasternum, hind coxae, and the lateral margins of the ventral segments are rugose, and the middle of the metasternum and abdomen are smooth.

P. orientalis can be distinguished from the very similar *P. brevitarsis* by having a more distinctly bilobed clypeus. *Protaetia aerata* (Erichson 1834) reported by Ma (1995) and *Potosia aerata* (Erichson 1834) listed by Hua (2002) have the same application as *Protaetia orientalis* Gory & Percheron 1833 (Krikken, 1984).

The first documented local record is by Lee & Winney (1981). It is probably the most commonly seen flower chafer in Hong Kong. It has been found feeding on various fruits including lychee (*Litchi sinensis*), figs and tomato (*Solanum lycopersicum*), as well as on flowers. Mating pairs kept in captivity laid eggs in August, with first instar larvae hatching in early September. Larvae fed on fermented sawdust, and pupated in March of the next year, with adults emerging in April and May.

Fig. 7.1 *Protaetia orientalis* - clypeus and pronotum

Fig. 7.2 A *Protaetia orientalis* - feeding on a flower

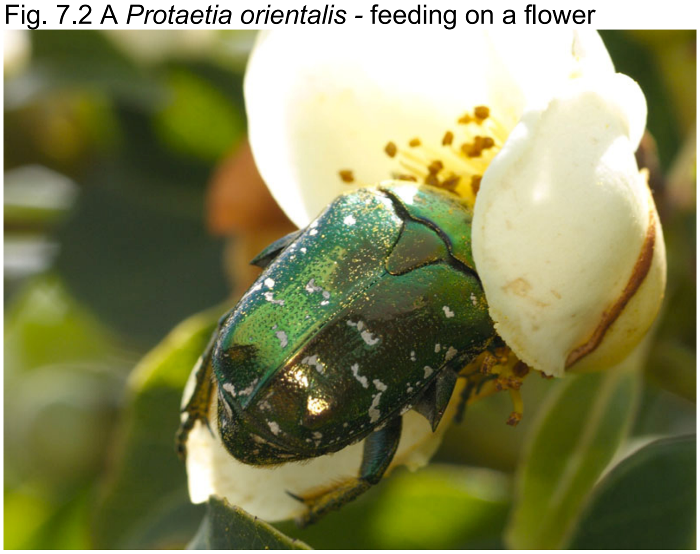


Fig. 7. 3 *Protaetia orientalis* - feeding on a ripe tomato

Fig. 7.4 *Protaetia orientalis* - ventral view

8. *Protaetia fusca* (Herbst 1790) 紡星花金龜

Body length 13-15mm, coppery, with the head, legs and ventral surface shiny; the pronotum, scutellum, elytra and pygidium matt chocolate-colour, finely and irregularly sprinkled with yellow points, most closely aggregated at the sides of the pronotum and in two masses at the outer edge of each elytron before and behind the middle. The head, legs, sides of the pronotum, sternum, abdomen and the pygidium are thickly clothed with recumbent yellow setae. The clypeus is broad, closely punctured and very feebly emarginate in the middle of the front margin. There are five longitudinal furrows in the disc of each elytron. The apical angles of the elytra are produced into long spines. The sternal process is very short and broad.

There are 18 specimens deposited in the Insect Museum, Tai Lung Experimental Station, Hong Kong, which were collected from 1963 to 1999, in Ta Shek Wu, Tai Lung and Ngau Tam Mei respectively, in the period of April to November.

Fig. 8.1 *Protaetia fusca* - dorsal view

Fig. 8.2 *Protaetia fusca* - clypeus and pronotum

Fig. 8.1 *Protaetia fusca* - ventral view

9. *Glycyphana nicobarica* Janson 1877
雙斑短突花金龜

Body length 9-12mm, matt; head black; pronotum, scutellum and elytra matt green; pygidium brick red; ventral surface glossy. Head bears two small spots at the base. Pronotum bears a marginal line on each side and a pair of discoidal spots (occasionally with an additional pair anteriorly). Each elytron bears five to eight spots. The head is densely punctured and moderately notched in the front. The sternal process is truncated and very short.

The first documented local record is by Yiu (2006). Although not abundant, it is commonly recorded in various localities in the New Territories, from March to October. It is often found feeding on flowers, including that of *Bidens alba*, *Rhus chinensis* and *Viburnum odoratissimum*. All 16 specimens deposited in the Insect Museum, Tai Lung Experimental Station, Hong Kong were collected from a compost of pig waste and sawdust, in 1993. Mated females laid eggs into fermented sawdust in captivity in September 2008 and new adults emerged in November of the same year.

Fig. 9.1 *Glycyphana nicobarica* - dorsal view

Fig. 9.2 *Glycyphana nicobarica* - dorsal view showing different colour

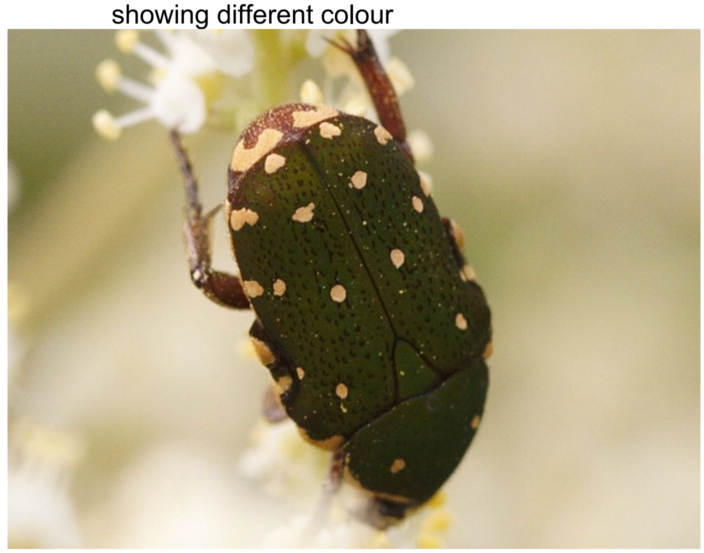


Fig. 9.3 *Glycyphana nicobarica* - lateral view

10. *Glycyphana nasalis* Boheman 1858
(未有中文名稱)
According to the original Latin description, the species has a body length of 14mm. Matt green. Head closely punctured. Prothorax moderately punctured, bearing two yellow spots dorsally, black laterally and shining ventrally. Elytra finely punctured, with 14 yellow spots unevenly distributed. Pygidium bears four spots.

Type originated from Hong Kong; no further record and information found thereafter.

11. *Gametis jucunda* (Faldermann 1835) 小青花金龜
Body length 11-16mm, matt dorsally, colour varying from green, olive, red, dark blue or black (Ma, 1995). All specimens so far recorded locally are green. Surface, clothed thinly dorsally and thickly ventrally with tawny hairs and setae, and decorated with yellow markings, consisting of a discoidal spot and a marginal line on each side of the pronotum, three to four at the outer margin and around three (sometimes absent) near the inner margin of each elytron. The head is densely and finely punctured. The clypeus is very bluntly bidented. The pygidium bears four transversely arranged spots.

Redtenbacher (1867) reported this from Hong Kong (as a synonym *Euryomia kuperi*). Recent local records: San Tau (Lantau) (28.viii.2005), feeding on flowers of *Caesalpinia bonduc*; Wong Chuk Yeung (Sai Kung) (14.ix.2008), feeding on flowers of *Rhus chinensis*; Yung She O (04.x.2008), feeding on flowers of *R. chinensis*; Tiu Shau Ngam (31.vii.2009), feeding on flowers of *Schima superba*.

Fig. 11.1 *Gametis jucunda* - dorsal view

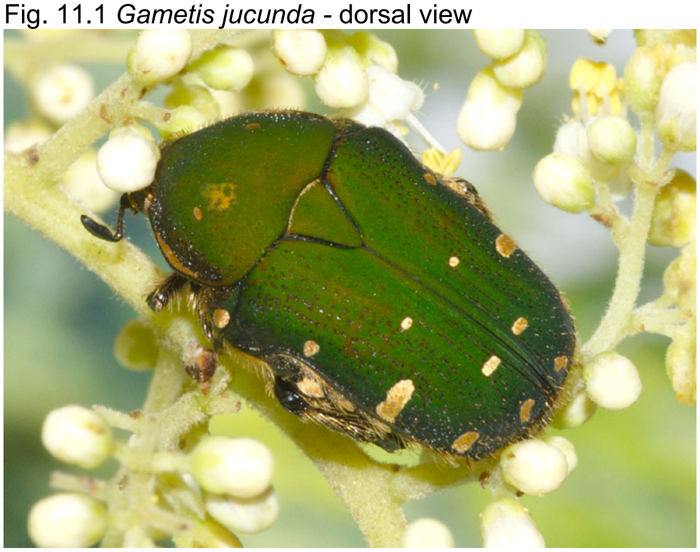
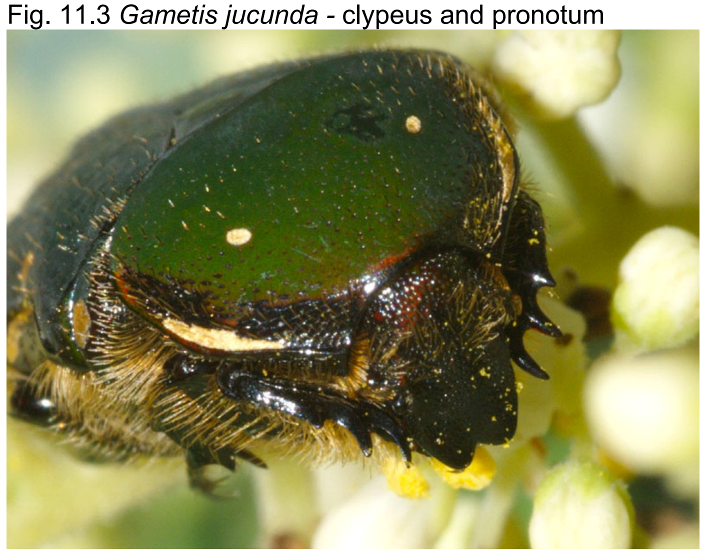


Fig. 11.2 *Gametis jucunda* - dorsal view showing variation of markings

Fig. 11.3 *Gametis jucunda* - clypeus and pronotum



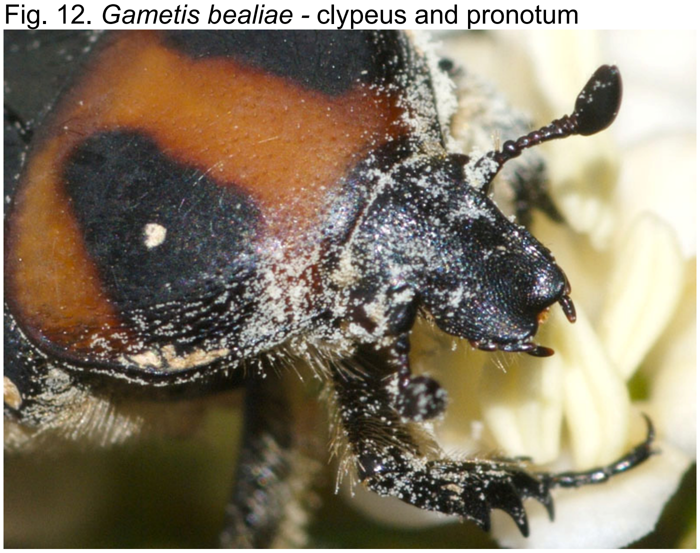
12. *Gametis bealiae* (Gory & Percheron 1833)
斑青花金龜
Body length 13-17mm. Structurally similar to *G. jucunda*. The prothorax brownish yellow, decorated with a pair of large black patches. Each patch usually has an additional small spot at the middle. Each elytron bears a large, more or less rectangular brownish yellow patch in the middle.

Arrow (1910) regarded this species as a variation of *G. jucunda*, however, this has not been generally accepted. Indeed *G. bealiae* is generally larger and not only the markings differ greatly between the two species; the punctures and ridges on the elytra are also generally more conspicuous in *G. jucunda*.

First local record reported by Yiu (2006). It has been recorded feeding on flowers of *Viburnum odoratissimum* and *Lonicera* sp., from March to May.

Fig. 12.1 *Gametis bealiae* - dorsal view

Fig. 12. *Gametis bealiae* - clypeus and pronotum



Gymnetini 柄花金龜族

13. *Euselates schoenfeldti* Kraatz 1893 海麗花金龜
Body length 18-21mm, black, clothed with yellowish brown pubescence. Clypeus deeply incised, with two longitudinal yellow stripes on the head. Pronotum with four longitudinal yellow stripes. Scutellum elongated, yellow, except small area at the middle of the two sides. Elytron marked with four to five yellow spots and two longitudinal red bands, one from anterior margin to the middle, dilating towards the suture of the elytra, the other starts from the anterior end of the first, runs along the anterior margin and the lateral margin, and dilates beyond the middle towards the suture. Pygidium almost semi-circular, marked with a large yellow spot in the middle and two small yellow spots on the sides.

First Hong Kong record (*Taeniodera galei*) reported by Waterhouse (1900). Recorded feeding on the flowers of *Cleistocalyx operculatus*, in June 2007 and June 2008 in Hok Tau.

Fig. 13.1 *Euselates schoenfeldti* - dorsal view

Fig. 13.2 *Euselates schoenfeldti* - lateral view

Fig. 13.3 *Euselates schoenfeldti* - pygidium

14. *Clinteria ducalis* White, 1856 黃斑絨花金龜

Body length 13.5-15mm, sooty black or blackish purple dorsally, thinly clothed with pubescence. Head, legs and ventral surface shining black. Clypeus quadrate, anterior margin slightly concave. Each elytron marked with two irregularly shaped yellow patches, the larger one at the middle and the smaller near the apex.

A new record for Hong Kong: Wong Chuk Yeung (Sai Kung) (13.ix.2008, 16.ix.2008), on flowers of *Rhus chinensis* ; Tiu Shau Ngam (01.iv.2009, 21.iv.2009), on flowers of *Rhaphiolepis indica* and flowers of *Homalium cochinchinensis* respectively.

Fig. 14.1 *Clinteria ducalis* - dorsal view

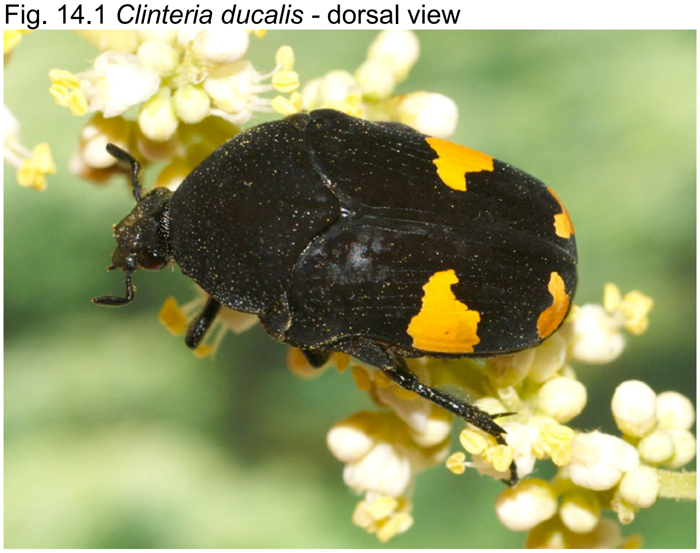


Fig. 14.2 *Clinteria ducalis* - lateral view

Fig. 12.2 *Clinteria ducalis* - clypeus and pronotum

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SHORT COMMUNICATION

Afromorgus pauliani (Haaf 1954), a second species of Trogidae (Coleoptera: Scarabaeoidea) recorded in Hong Kong

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Key words: Trogidae, China, Hong Kong.

The Trogidae are quite distinctive and can be identified from other species of Scarabaeoidea occurring in Hong Kong, by having: 10-segmented antennae, with a 3-segmented club, segments which are capable of apposition; mid-coxal cavities are contiguous and closed laterally by a broad meeting of the meso- and meta-sternum; abdomen with five visible ventrites. Trogidae are tough, heavily sclerotised, dull-coloured beetles, with the upper surface heavily tubiculate and with a strongly deflexed head.

Adults and larvae feed on dried animal remains (giving them the common name of Hide Beetles), being one of the last in a succession of insects that invade carcasses (Lawrence & Britton 1991).

Two specimens were found near lights in Wang Tong village, Lantau, on 5 and 20 June 2008, both attracted by village lights close to Wang Tong cemetery. The specimens were identified by Shinya Kawai as *Afromorgus pauliani* (Haaf 1954).

According to Pittino (2006), the Chinese distribution of *A. pauliani* is limited to Henan, Hubei, Taiwan and southwestern China. It is also distributed in Vietnam, Laos, India and Nepal. The only other species of Trogidae recorded locally is *A. chinensis* (Boheman 1858), which was described from Hong Kong island. *A. pauliani* at 15mm is much larger than *A. chinensis* (11mm). Also, *A. pauliani* has larger tubercles on the elytra.

Figure 1. *Afromorgus pauliani* Haaf 1954. Length 15mm. 5 June 2008 Wang Tong, Mui Wo, Lantau.

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(2) to promote conservation of Hong Kong insects;

(3) to further the scientifically sound and progressive study of entomology;

(4) to co-ordinate the recording and compilation of information on Hong Kong insects and to distribute information to other organisations and individuals for purposes of education, conservation and appreciation of insects; and

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